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# Energy Efficient Downlights for California Kitchens

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*Lawrence Berkeley National Laboratory*



# Project Objective

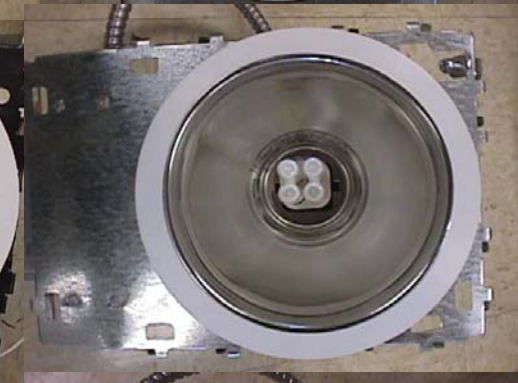
Develop a CFL downlight system  
for kitchen applications that is:

- low-cost
- high-efficiency
- builder-friendly

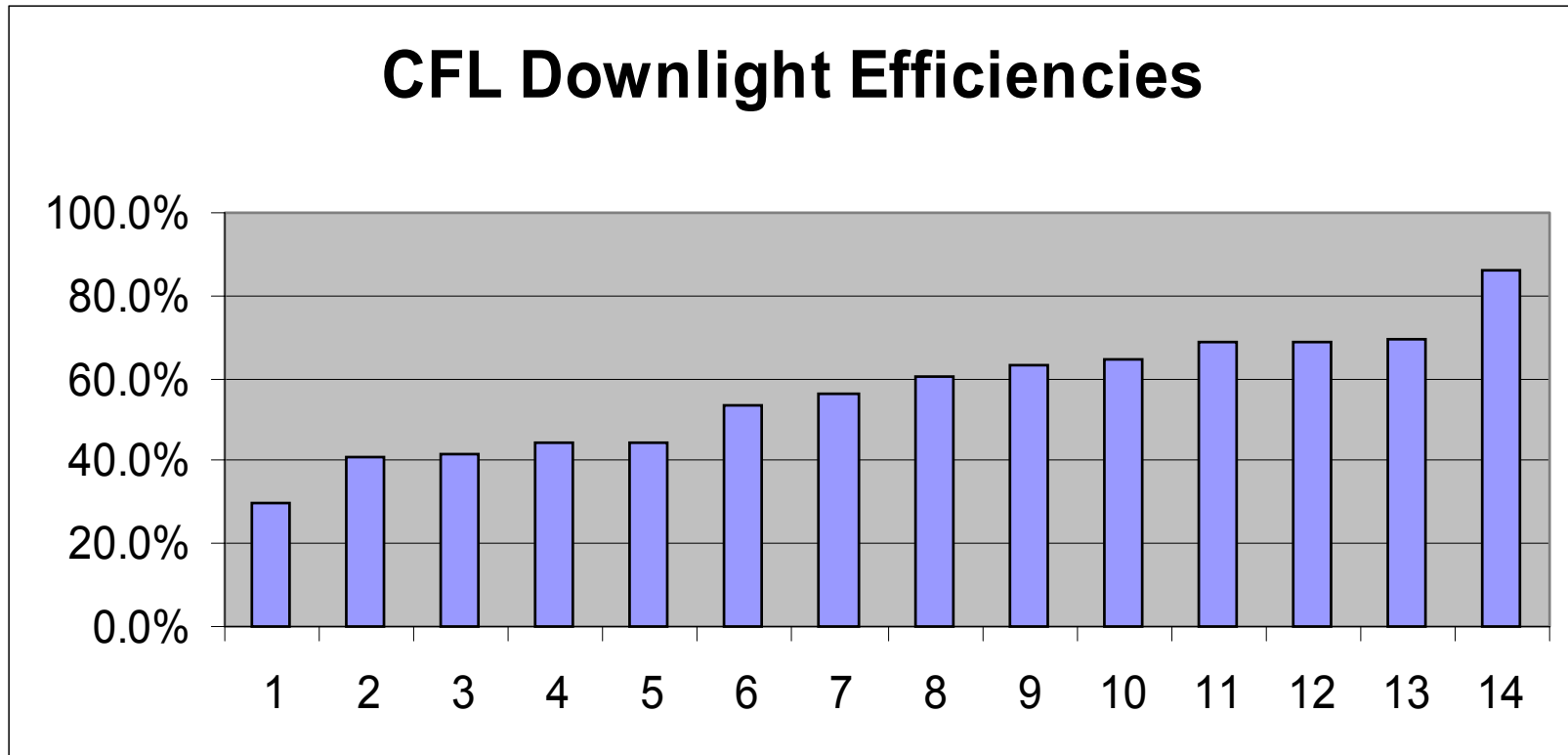
# Today's Topics

Background Research

New Concepts

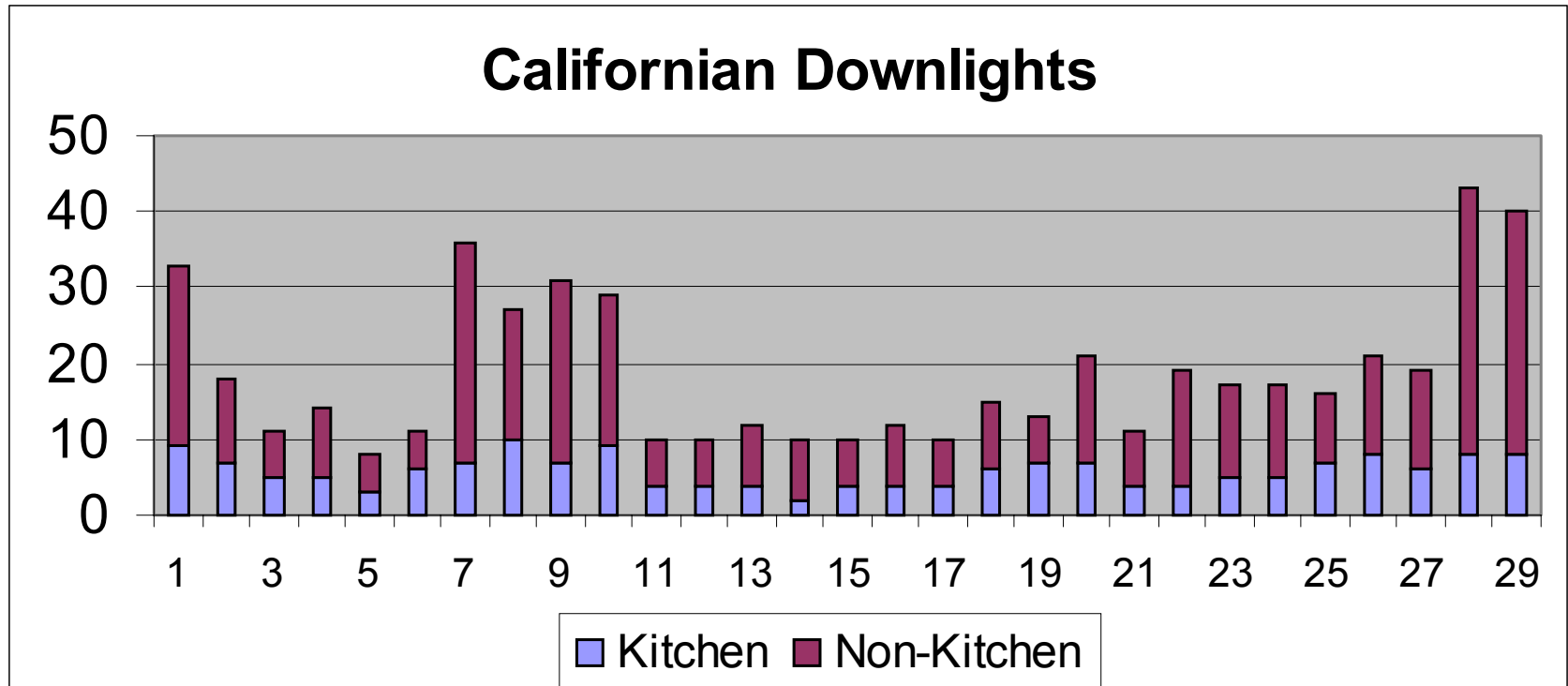


# Background Data - Existing CFL downlights

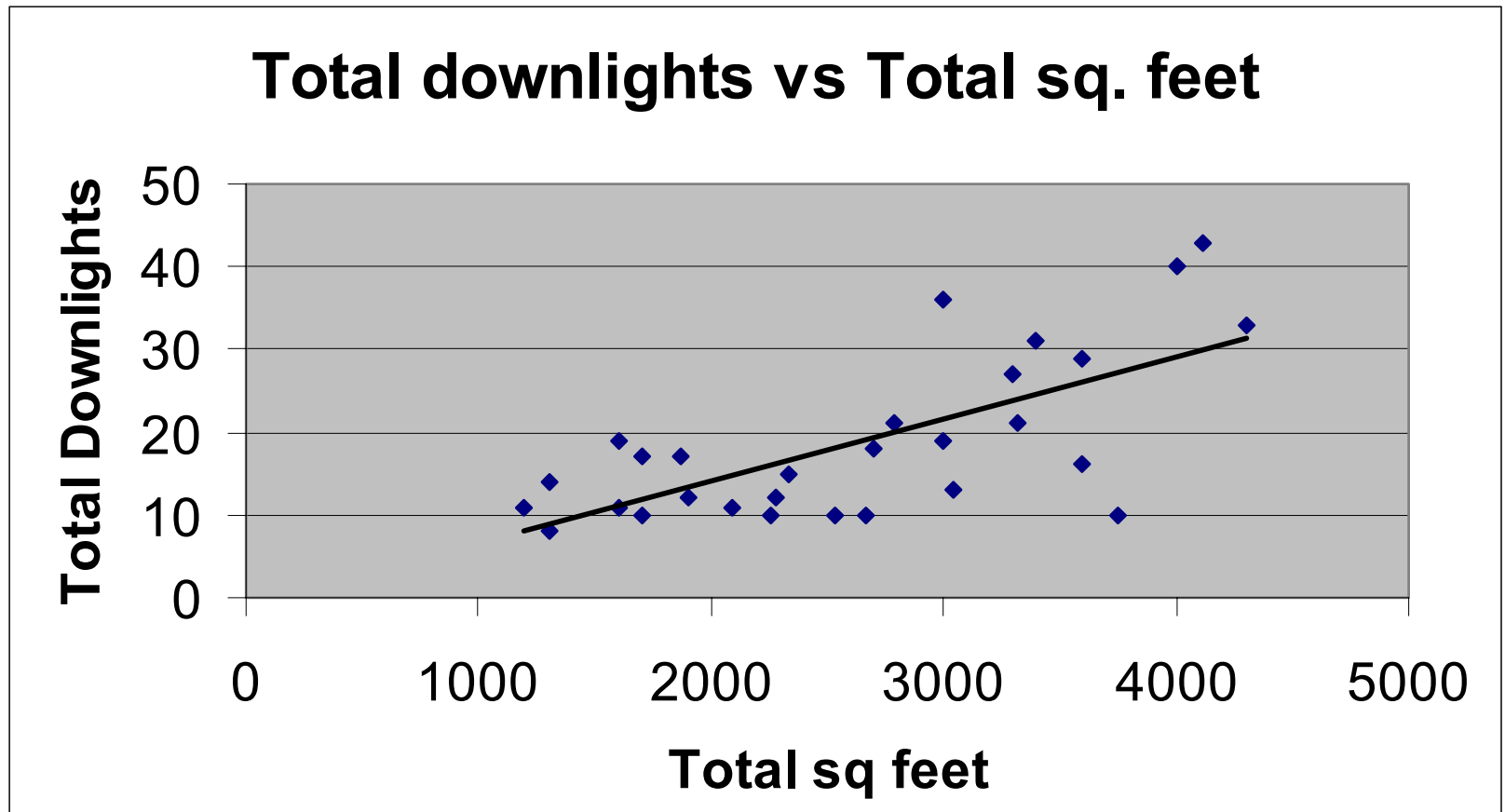


- Wide range of efficiency (30%-80%)
- Average efficiency = 55%, Average LPW = 35

# Background Data - Review of Drawings



# Background Data - Review of Drawings



# Builder Site Visits

- Established contacts through SMUD
- Developed draft survey and outreach material
- Conducted site visits
- Conducted surveys/interviews



# Builder Site Visits

## *Builders Visited Included:*

Centex Homes

Dunmore Homes

Ryland Homes

JTS Homes

John Lang Homes

Marticus Electric Inc

# Builder Site Visits

Understand installation process

- Framing
- Wiring
- Fixtures
- Sheetrock
- Finishing

# Downlight Installation

## *Step 1: Ceiling Wired*



# Downlight Installation

## *Step 2: Fixtures Nailed and ...*



# Downlight Installation

## *Step 3: ...Wired*





# Downlight Installation

*Step 4: Install Sheetrock*

*Step 5: Cut Downlight Holes*



# Downlight Installation

## *Step 6: Tape and Matte*



# Downlight Installation

## *Step 7: Finish Work*





# Downlight Installation

## *Problems with holes*



# Downlight Installation

## *Problems with holes*



# Builder Site Visits - *Downlight Installation Process*

- Multi-trade
- Inexpensive fixtures
- Complicated and involved
- Error prone (misalign sheet rock holes, etc.)
- Large labor savings potential
- Title 24 requires separate circuit and system

# Key Issues and Opportunities

- Major concern from all parties about the amount of flux from CFL downlights
- Major concern from all parties about the quality of light from CFL downlights (hum, flicker, color, interference, etc.)
- Downlights are popular because of: clean look, flexibility, and consumer perceptions of a “quality” lighting system

# Key Issues and Opportunities

- General support for a “system approach” that addresses the flux and the quality issues while satisfying Title 24 – even if it costs more
- General agreement that a higher cost lighting system could be justified, if done right, as it could be an added sales feature
- Major opportunities for a *Lighting Upgrade Package*

# Issues With Title 24 Compliant Kitchens



- 1/4 of kitchen lighting cost is due to Title 24 compliance
- Two dedicated lighting circuits are installed
- All CFL fixtures use magnetic ballasts
- Consumers “usually replace” CFL fixture

# Today's Topics

Background Research

New Concepts

# Concept

## Integrated Kitchen Lighting System



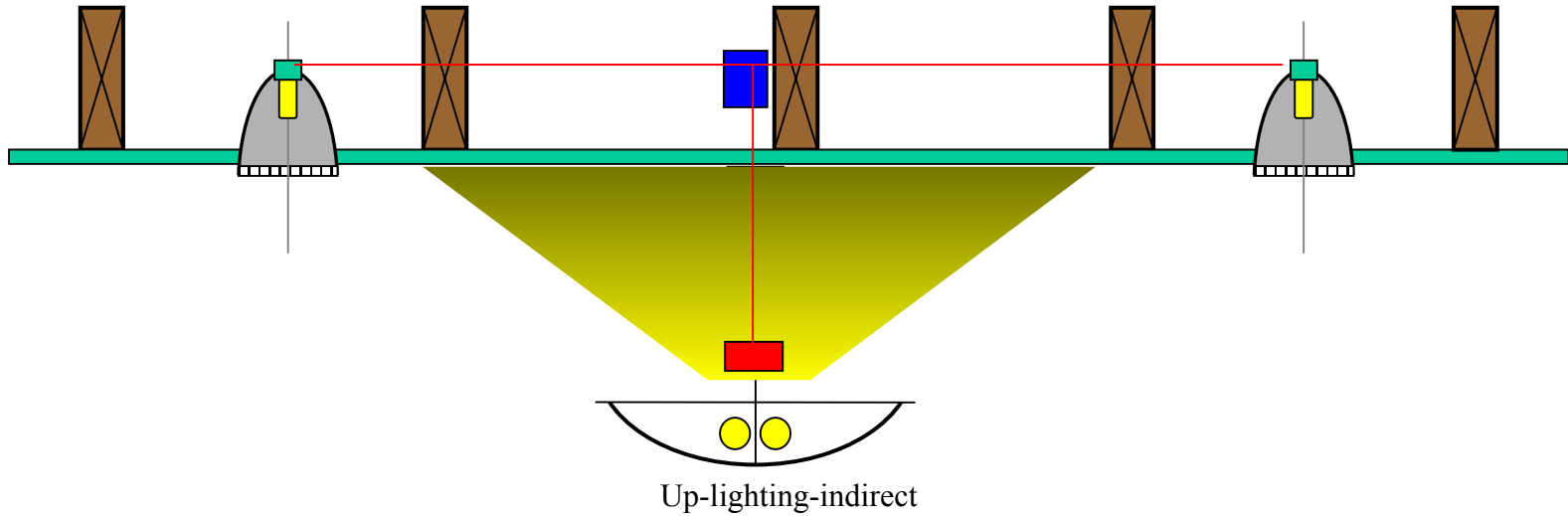
# Concept Definition

- Unified system (performance and energy one system does all approach)
- Plug and play components (reduced labor)
- Easy installation (reduced labor)
- Expandable (options oriented)
- Layered lighting (increase lighting quality)

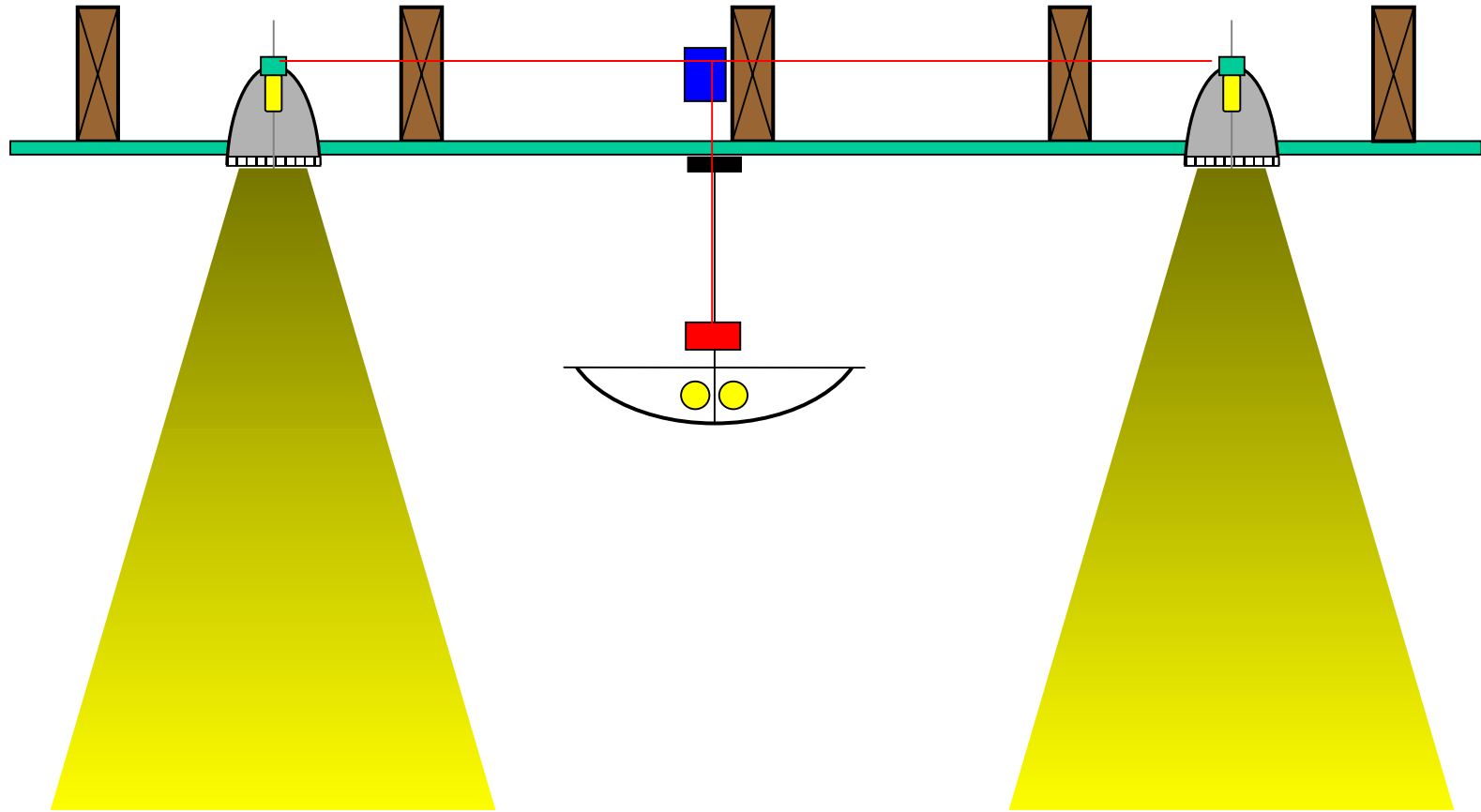
# Layered Lighting

- Central Linear Fluorescent
  - general ambient illumination
- Direct Downlighting
  - task and accent illumination
- Combination

# Integrated layered concept

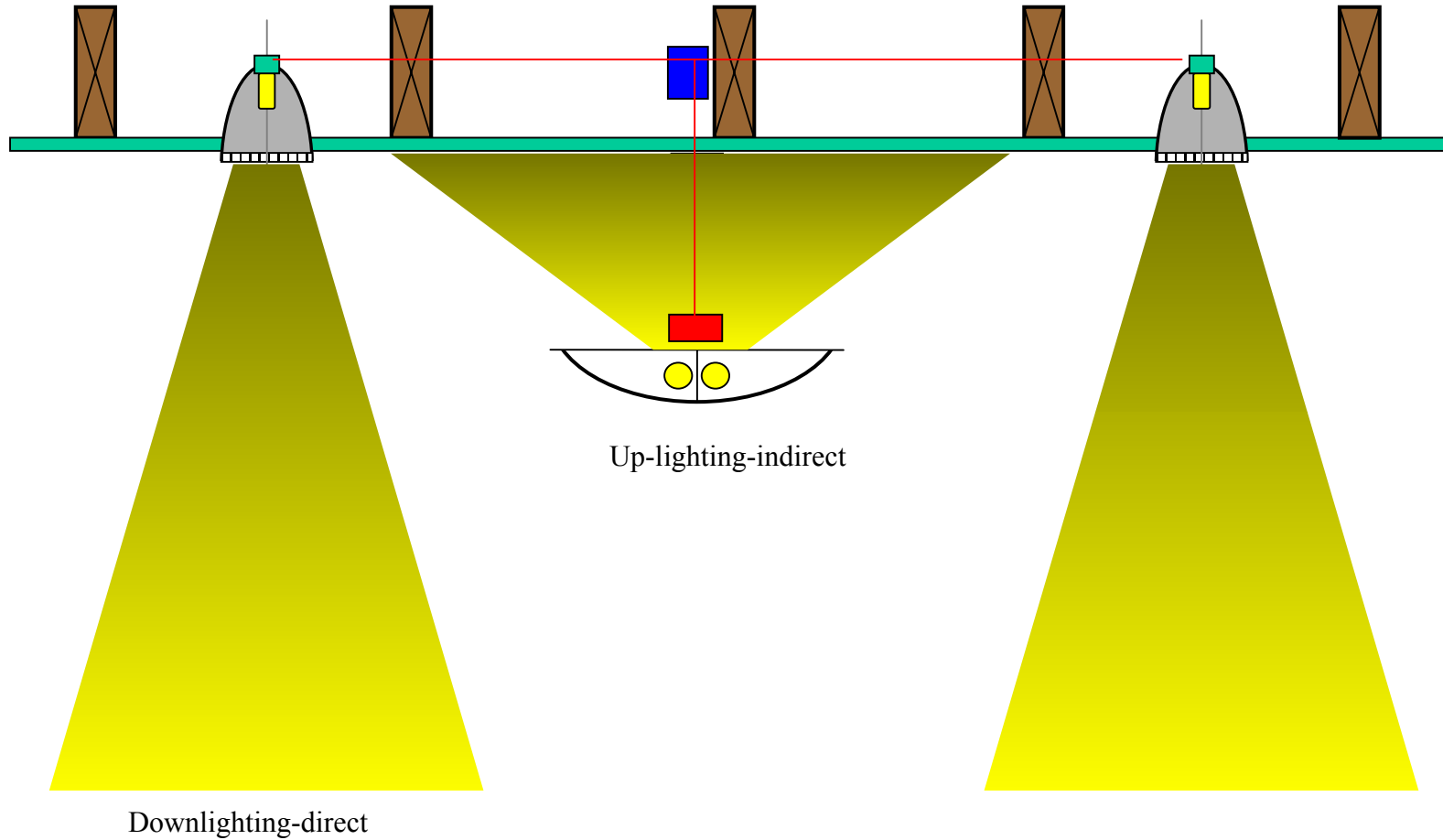


# Integrated layered concept

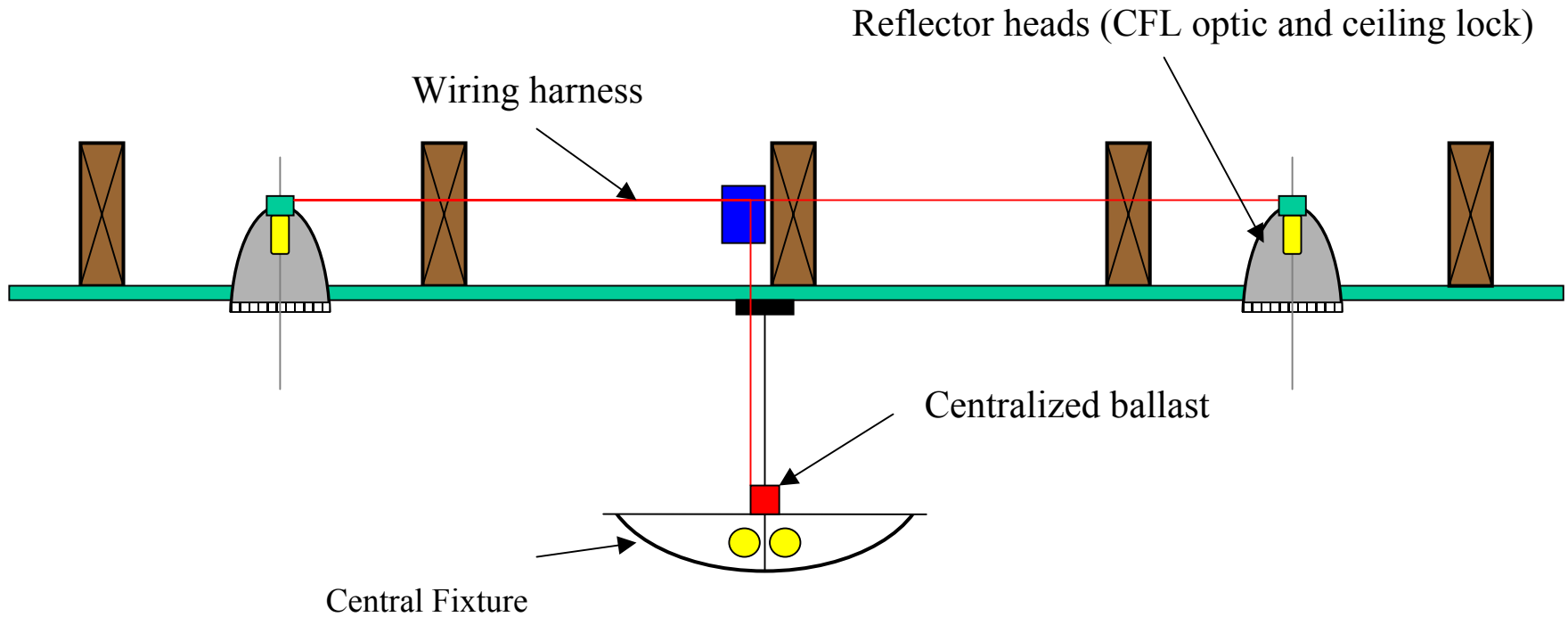


Downlighting-direct

# Integrated layered concept



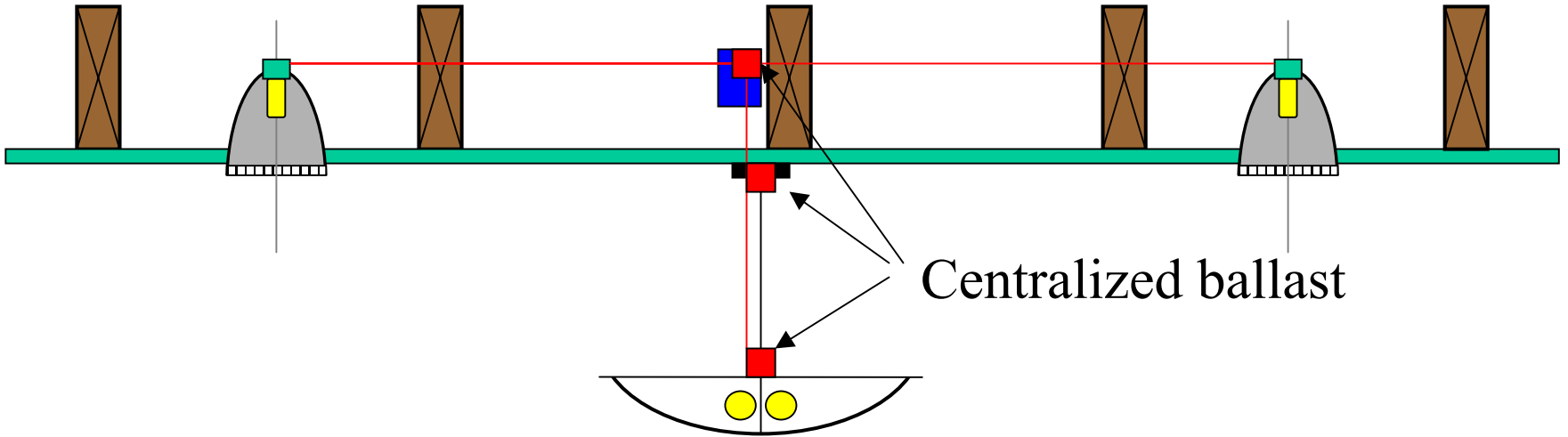
# Integrated Layered Concept



# System Options

- Number of downlights
  - 2,4,6,8
- Type of central fixture
  - direct,indirect, pendent, surface mount, etc.
- Controls
  - dimming, switching

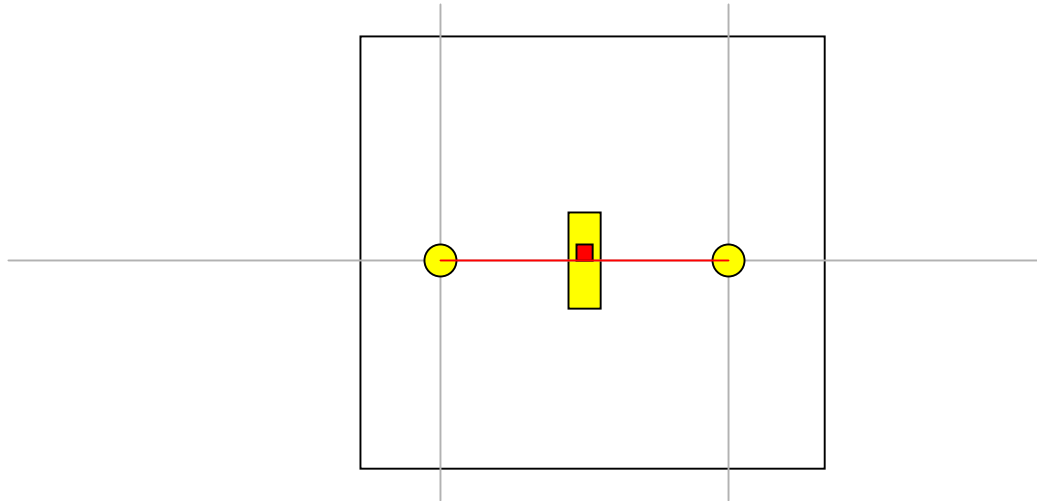
# Benefits of a Centralized ballast



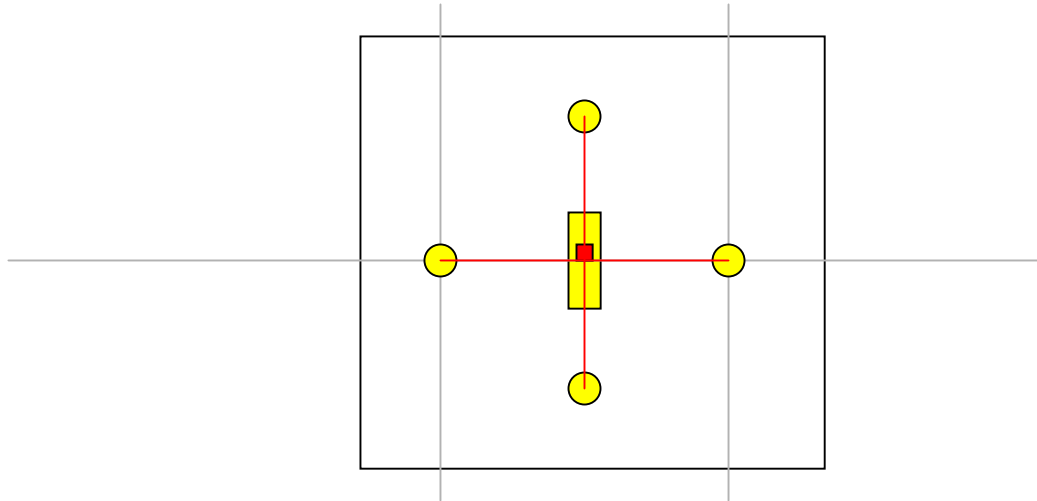
- Remote thermal environment
- System maintenance
- Options approach
- Ease of installation (plug and play)



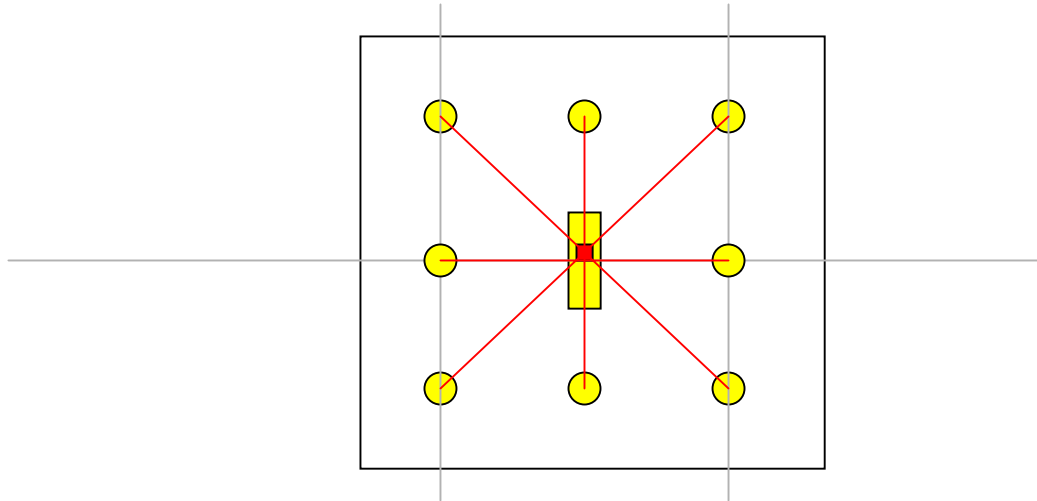
# Flexible layout-centralized ballasting



# Flexible layout-centralized ballasting



# Flexible layout-centralized ballasting



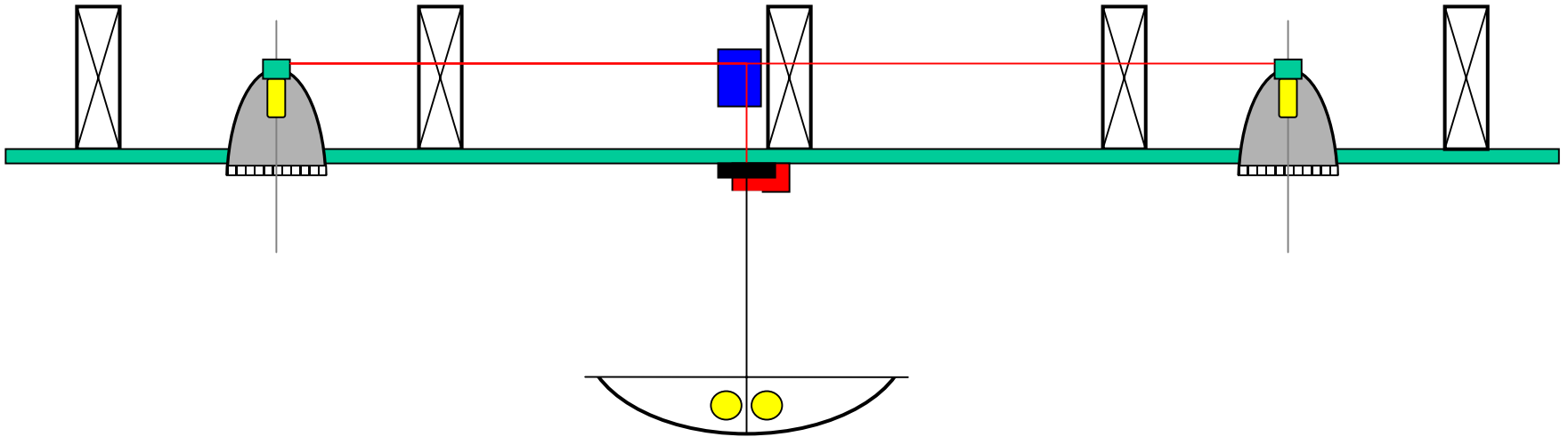
# Benefit of Central Luminaire

- Thermal isolation for centralized ballasting
- Low cost/high efficacy fluorescent
- Quality lighting
  - Indirect
  - Vertical illuminance
- Layered approach
- Ease of maintenance
  - ballast changing
- Flexible Controls
  - reduced light/power demand

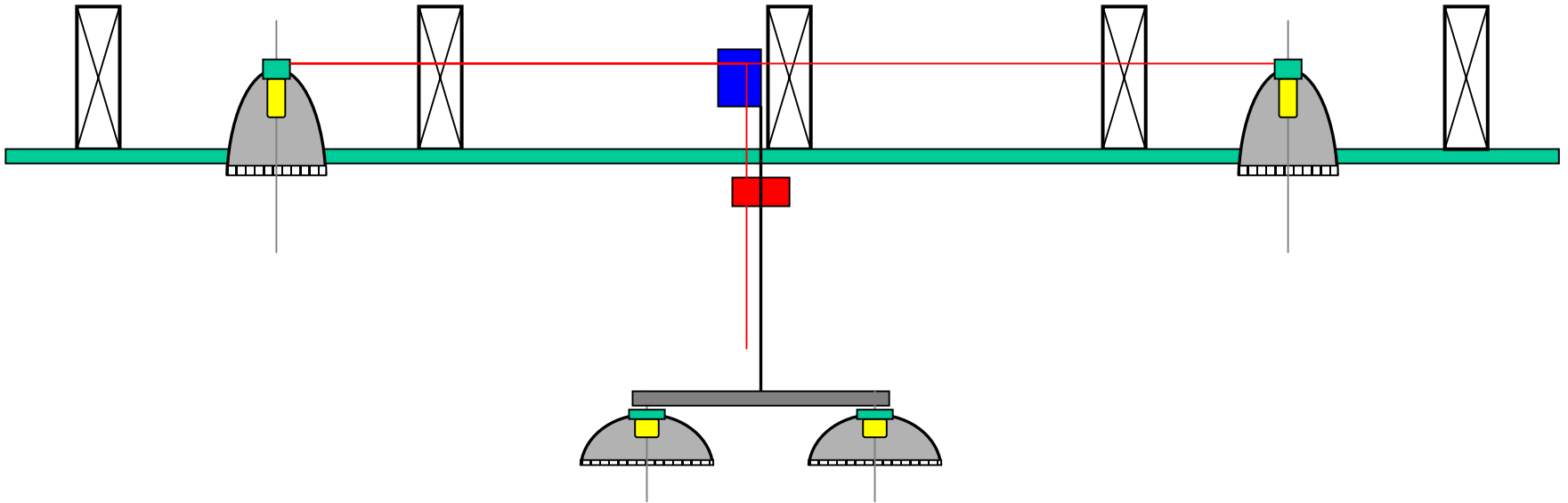
# Central Luminaire Alternatives

- Indirect linear fluorescent
- Direct linear fluorescent
- Enclosed drum/cloud
- Uplight downlight -glass/prismatic
- Multiple pendants

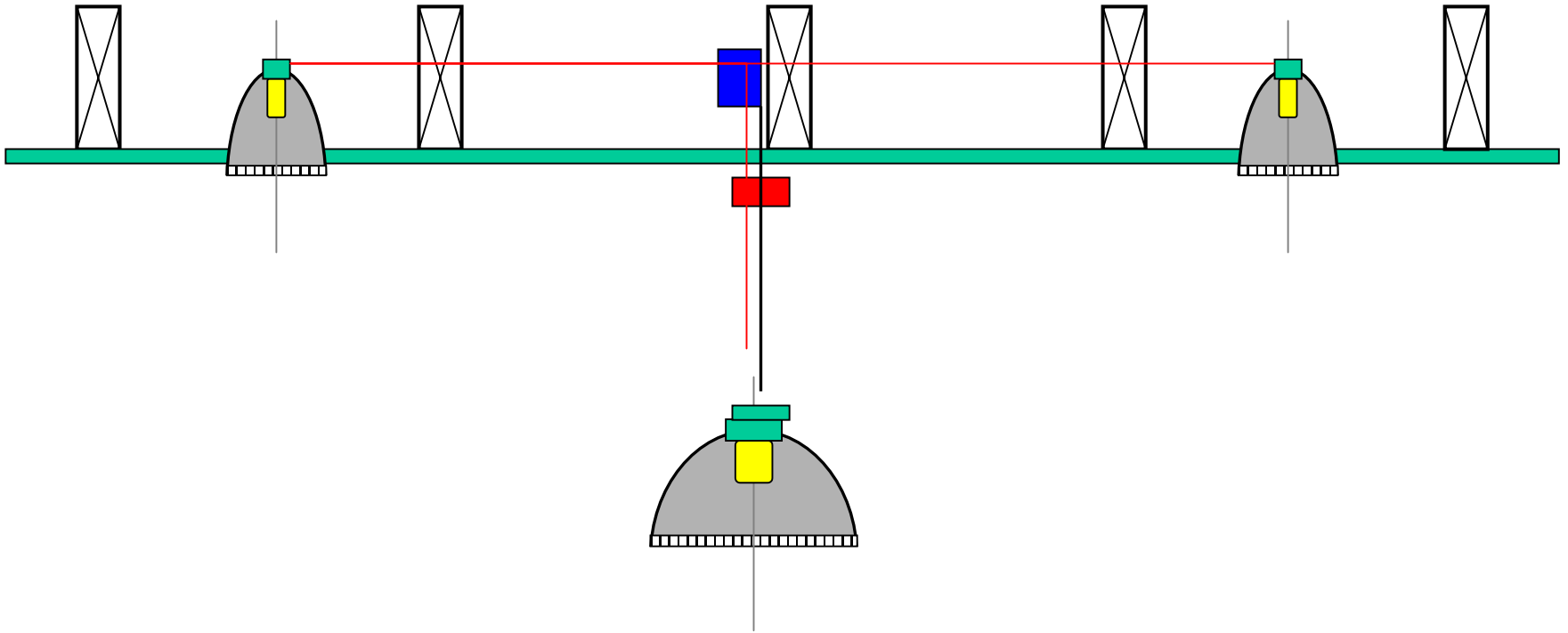
# Integrated layered concept- indirect option



# Integrated layered concept-multiple direct

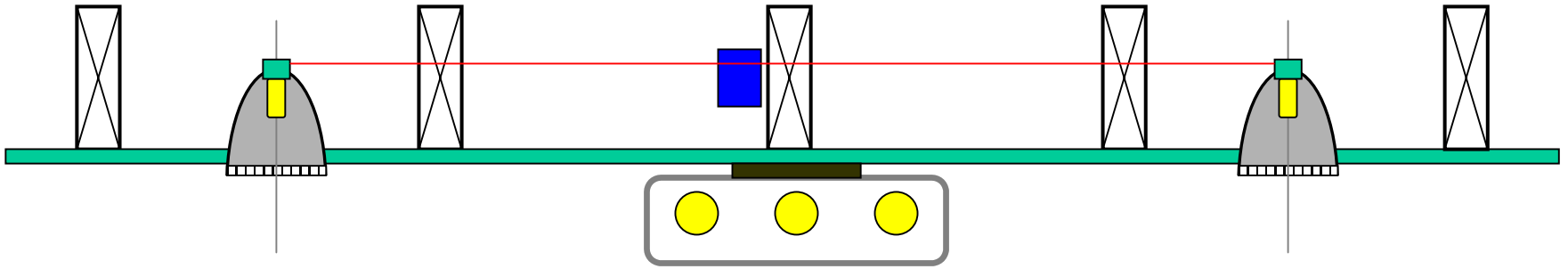


# Integrated layered concept-single direct

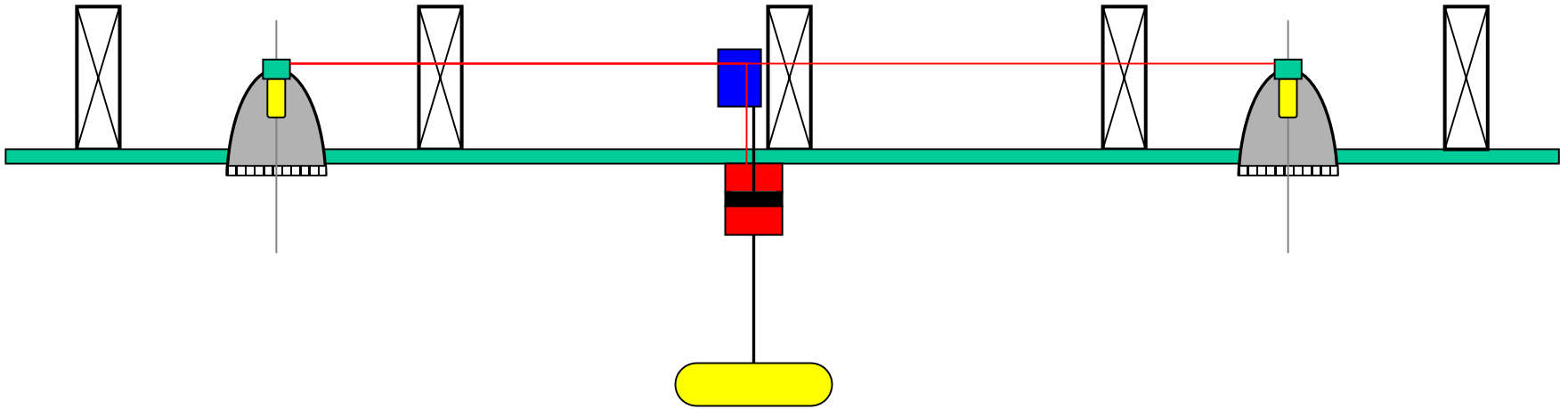




# Integrated layered concept-surface mount



# Integrated layered concept- pendant wrap



## Concept 2:

New Installation Technique

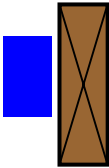
## Installation Concept - *Proposed Benefits*

- Reduced number of steps in installation
- Potential to reduce cost
  - low probability
- Potential to reduce installation errors
  - high probability

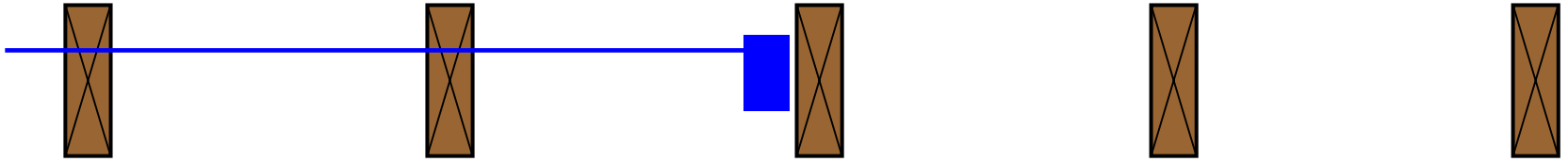
Integrated layered concept-**empty cavity**



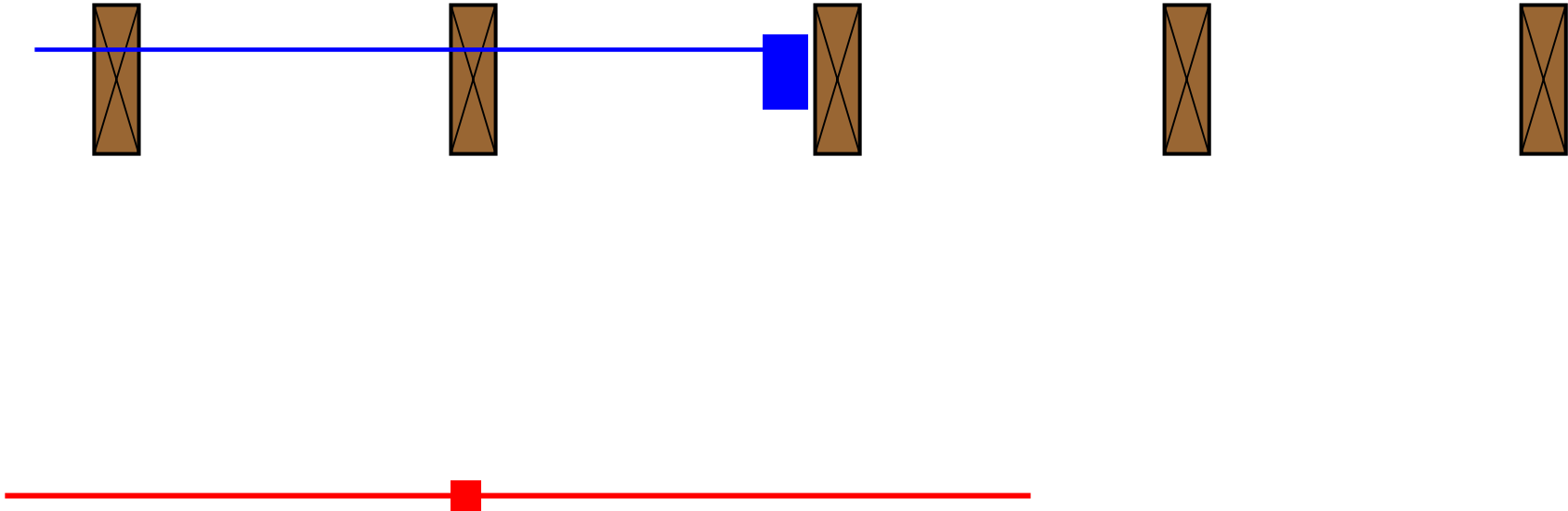
Integrated layered concept- junction box



# Integrated layered concept-wiring to junction box

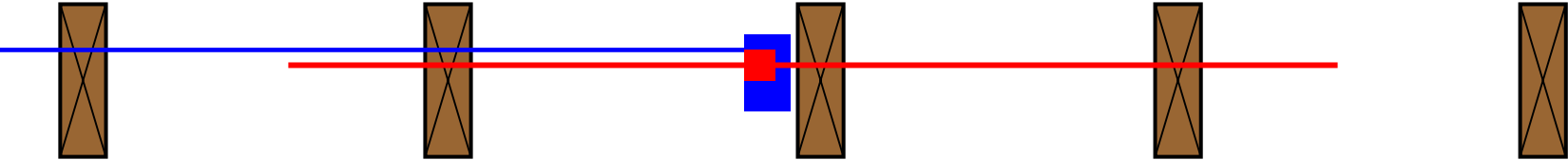


# Integrated layered concept-wiring harness

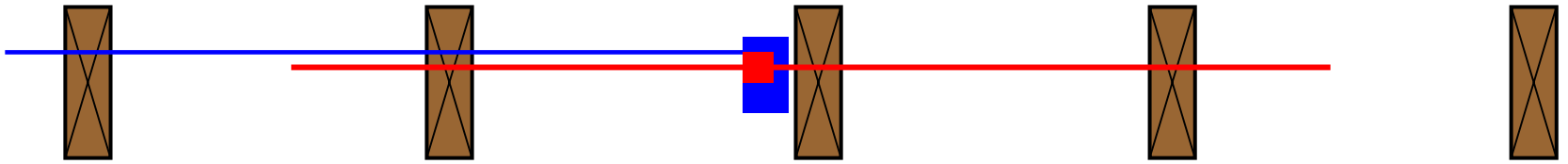




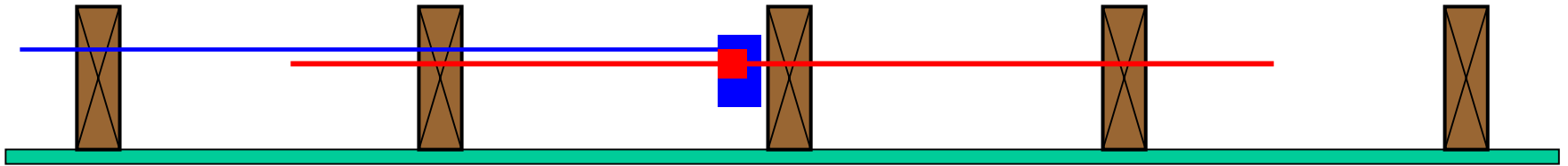
# Integrated layered concept-wiring harness



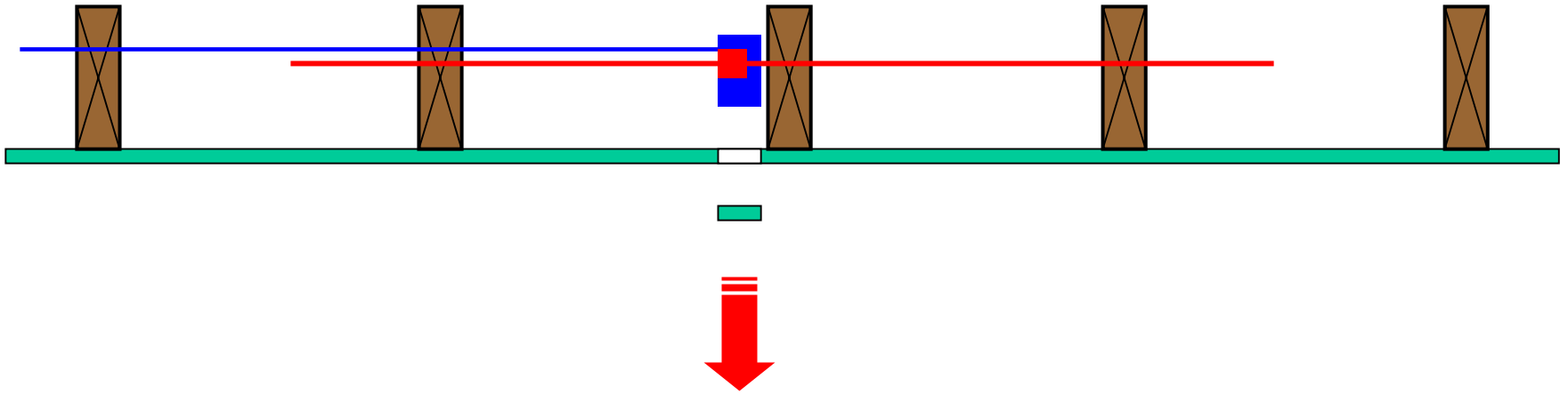
# Integrated layered concept-lay sheet rock



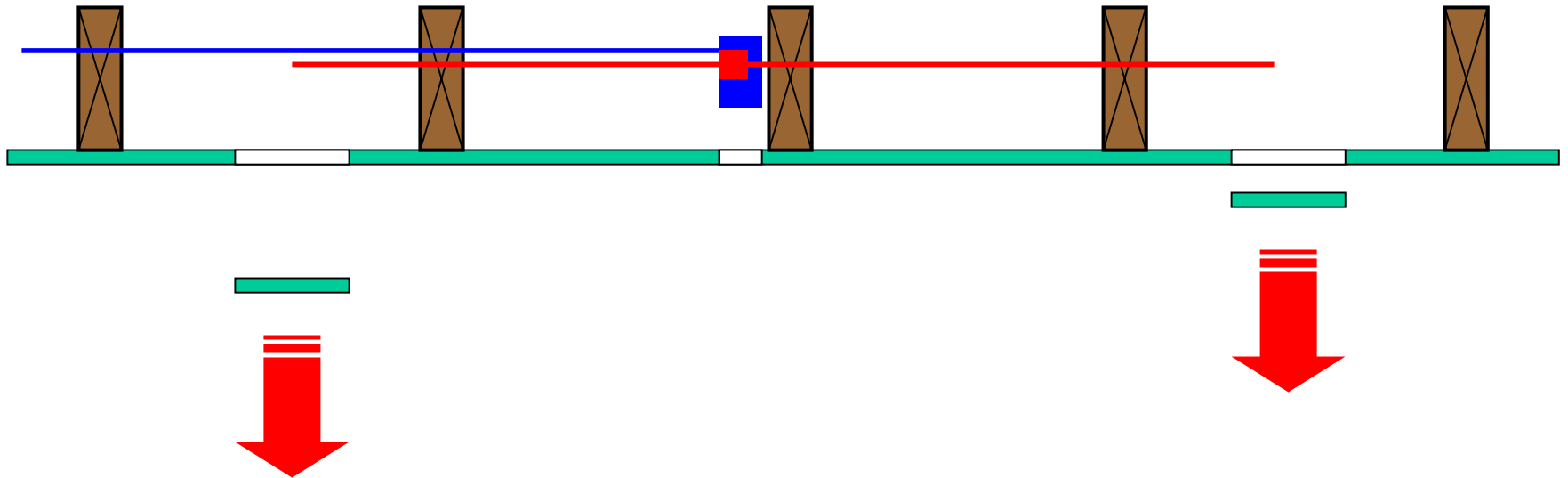
Integrated layered concept **tape, mud, sand, paint**



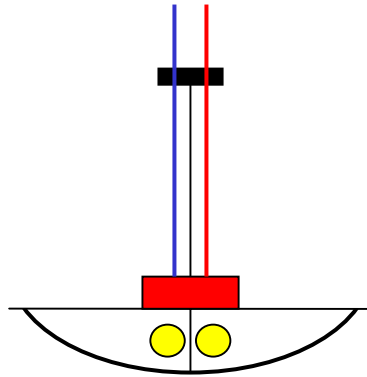
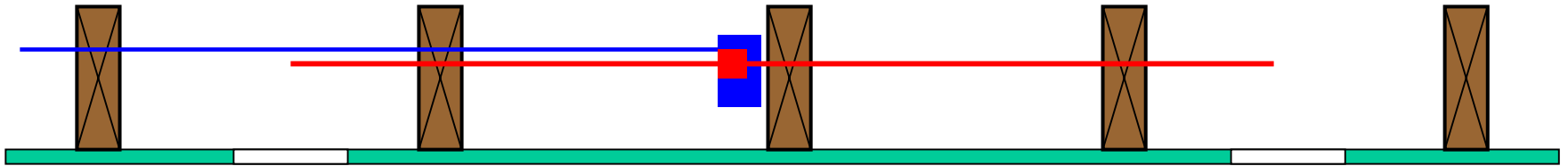
Integrated layered concept- **remove hole for J-box**



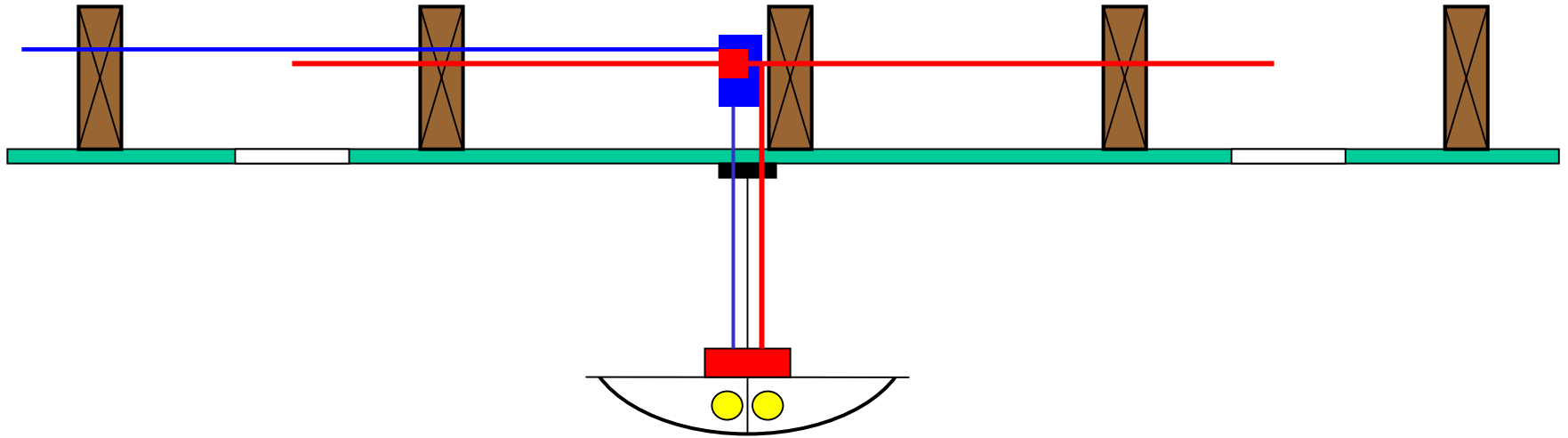
# Integrated layered concept- drill rounds for reflector heads



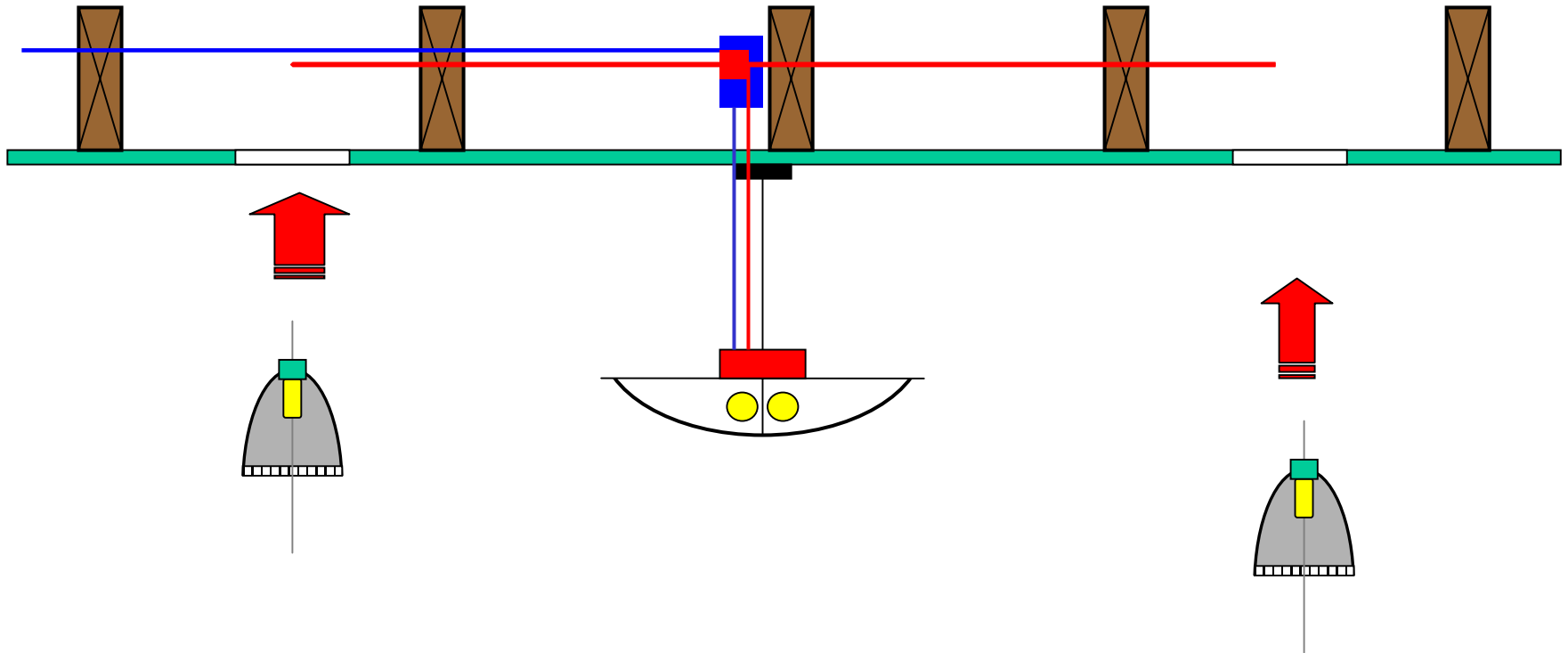
# Integrated layered concept- attach central fixture



# Integrated layered concept-attach central fixture

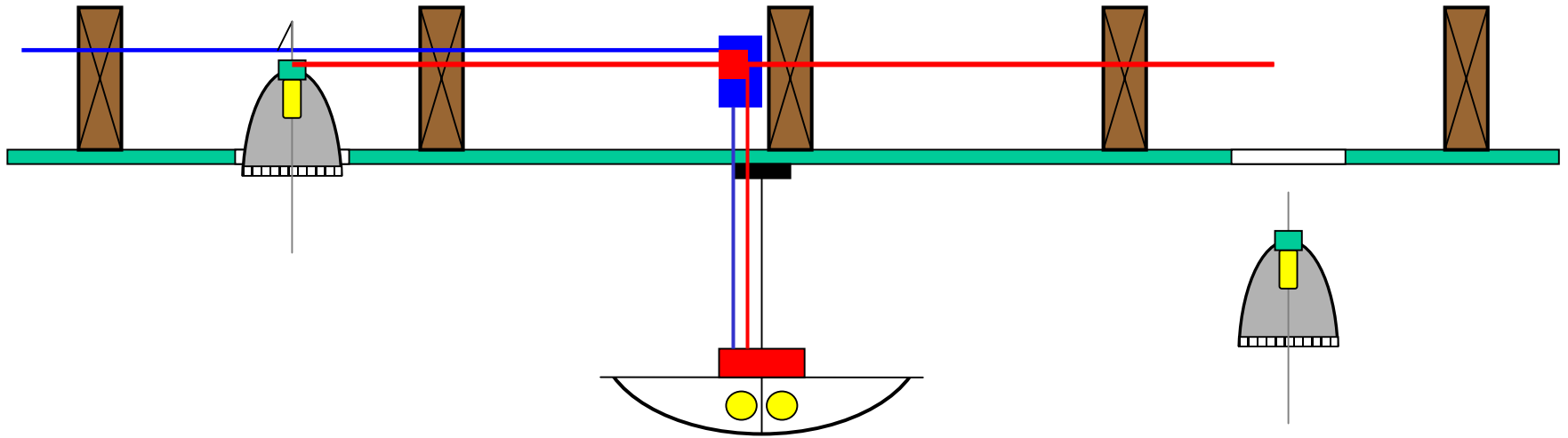


# Integrated layered concept-insert reflector heads

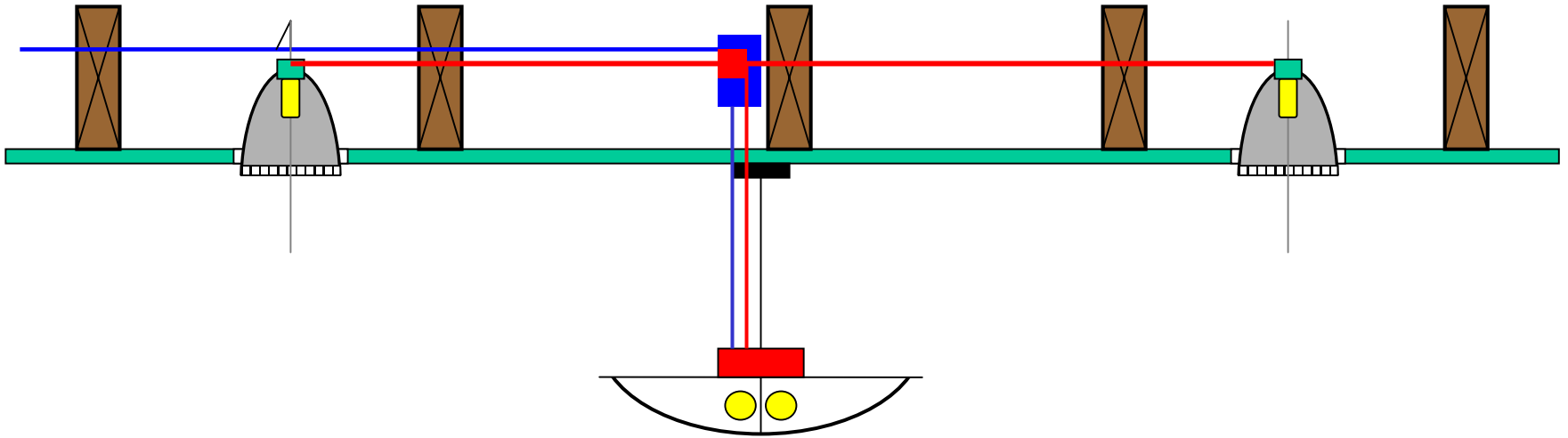




# Integrated layered concept-insert reflector heads

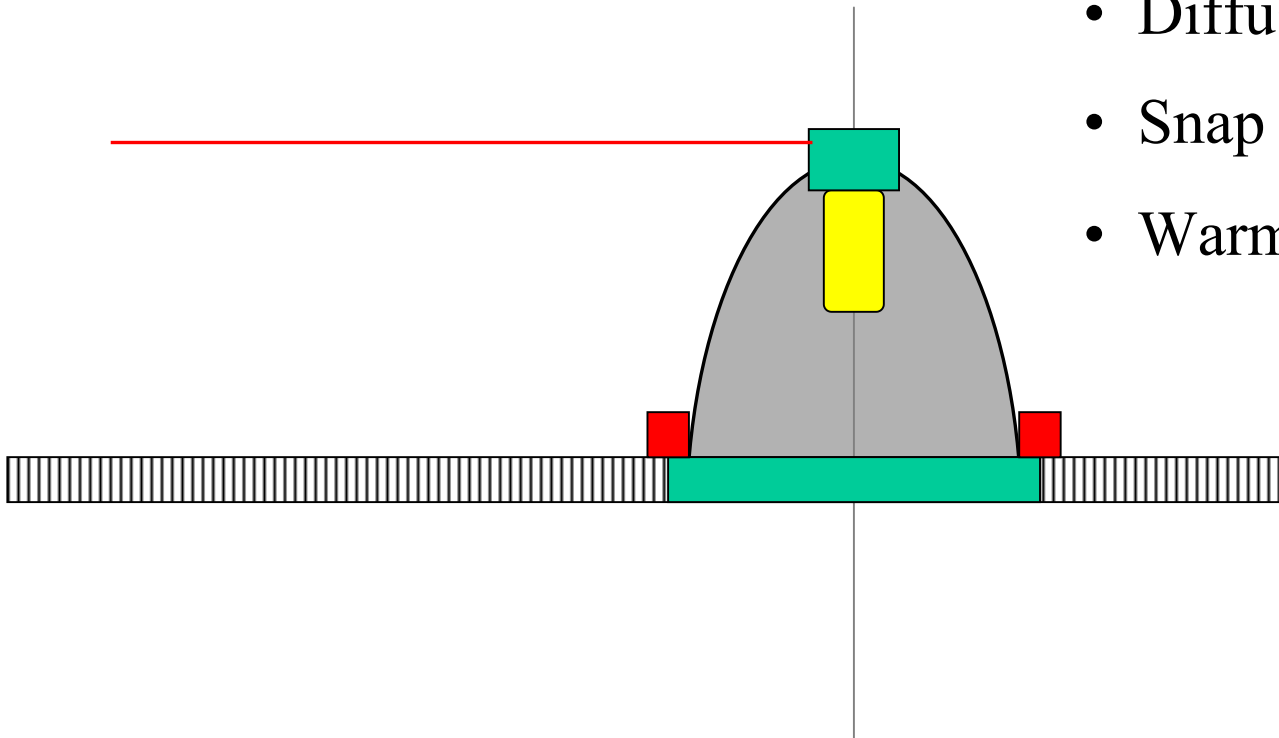


Integrated layered concept- insert reflector heads



## Downlights: optical head attributes

- Simple cross section
- Plug in supply
- Diffuse optics
- Snap lock support
- Warm pigment/filter



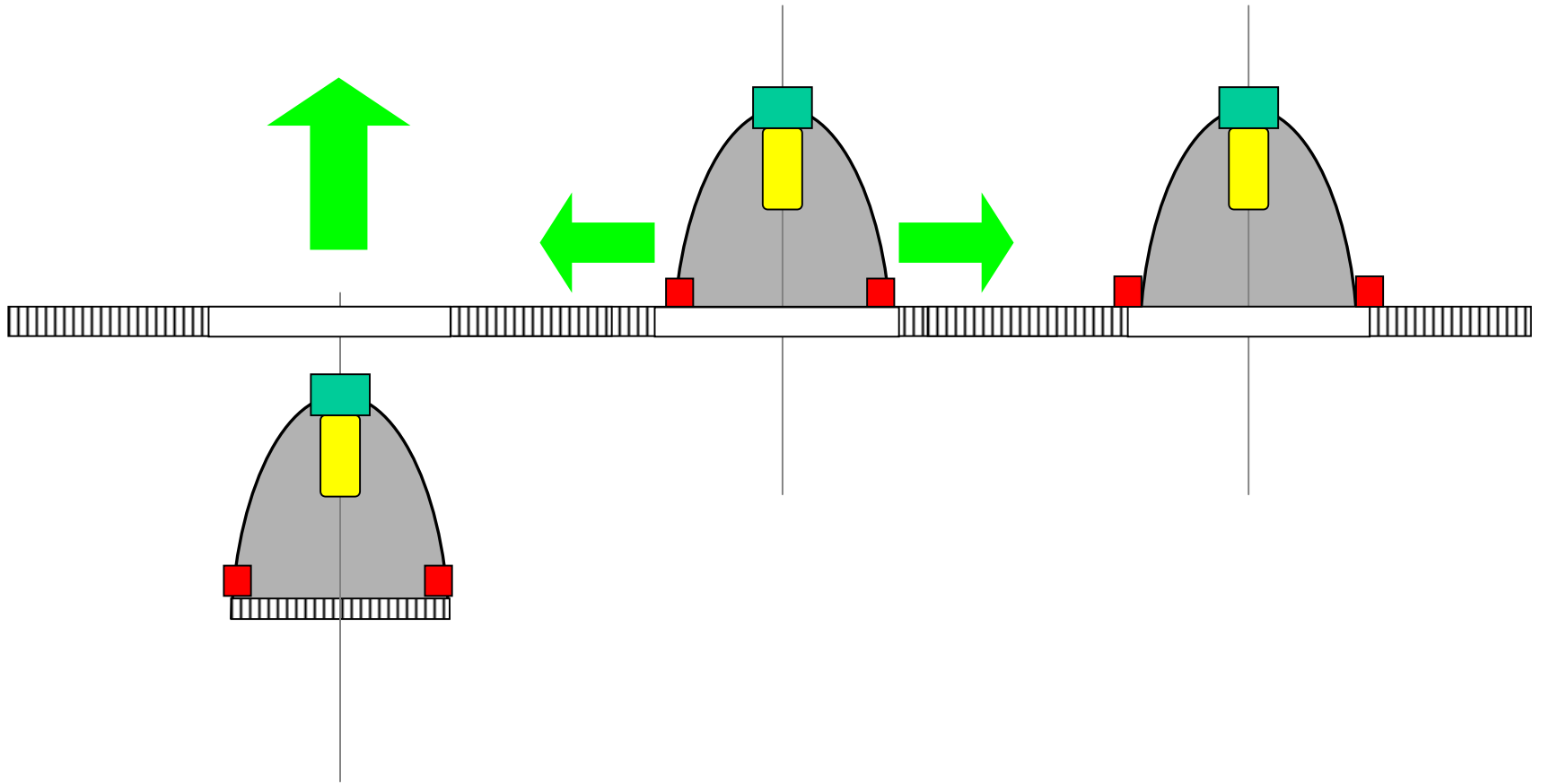
# Reflector Head Installation

- Plug in connection (electrical)
- Ceiling installation

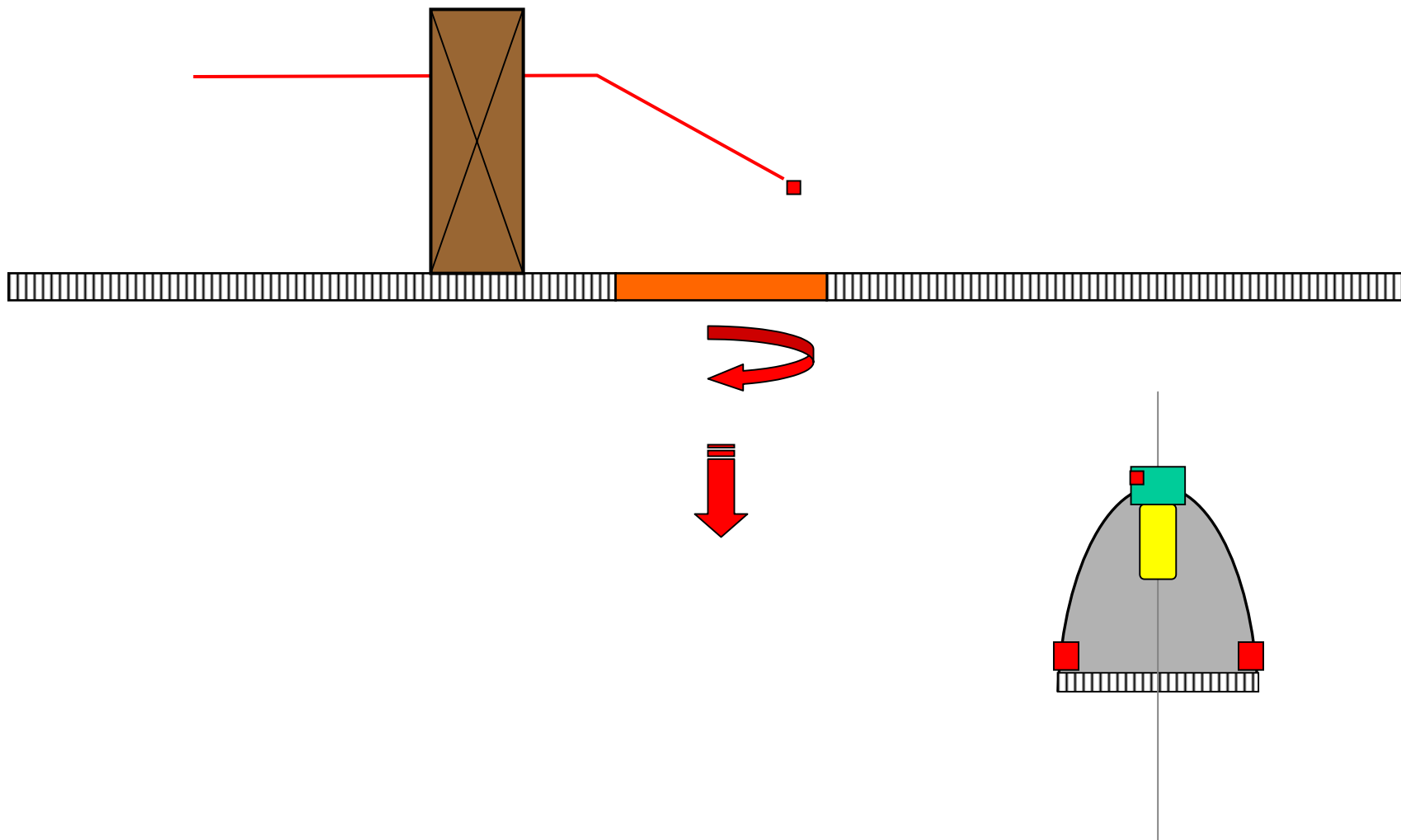
# Ceiling Installation

- Reduced labor
- Reduced call backs (misalignment)
- Flexible location
- Ease of retrofit/renovation

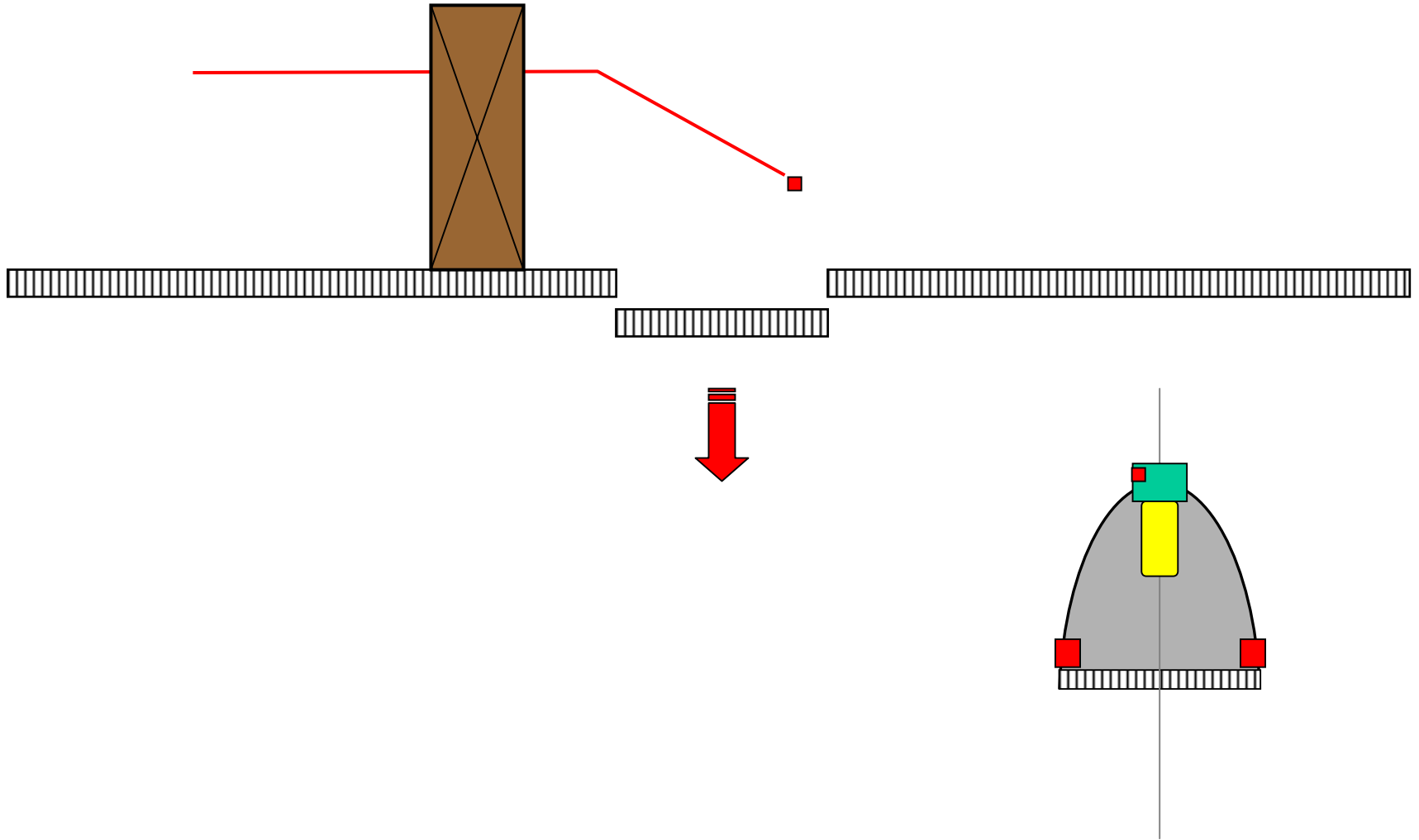
# Snap in Lock Support



# Snap in Lock Support and Plug-in Wiring Harness

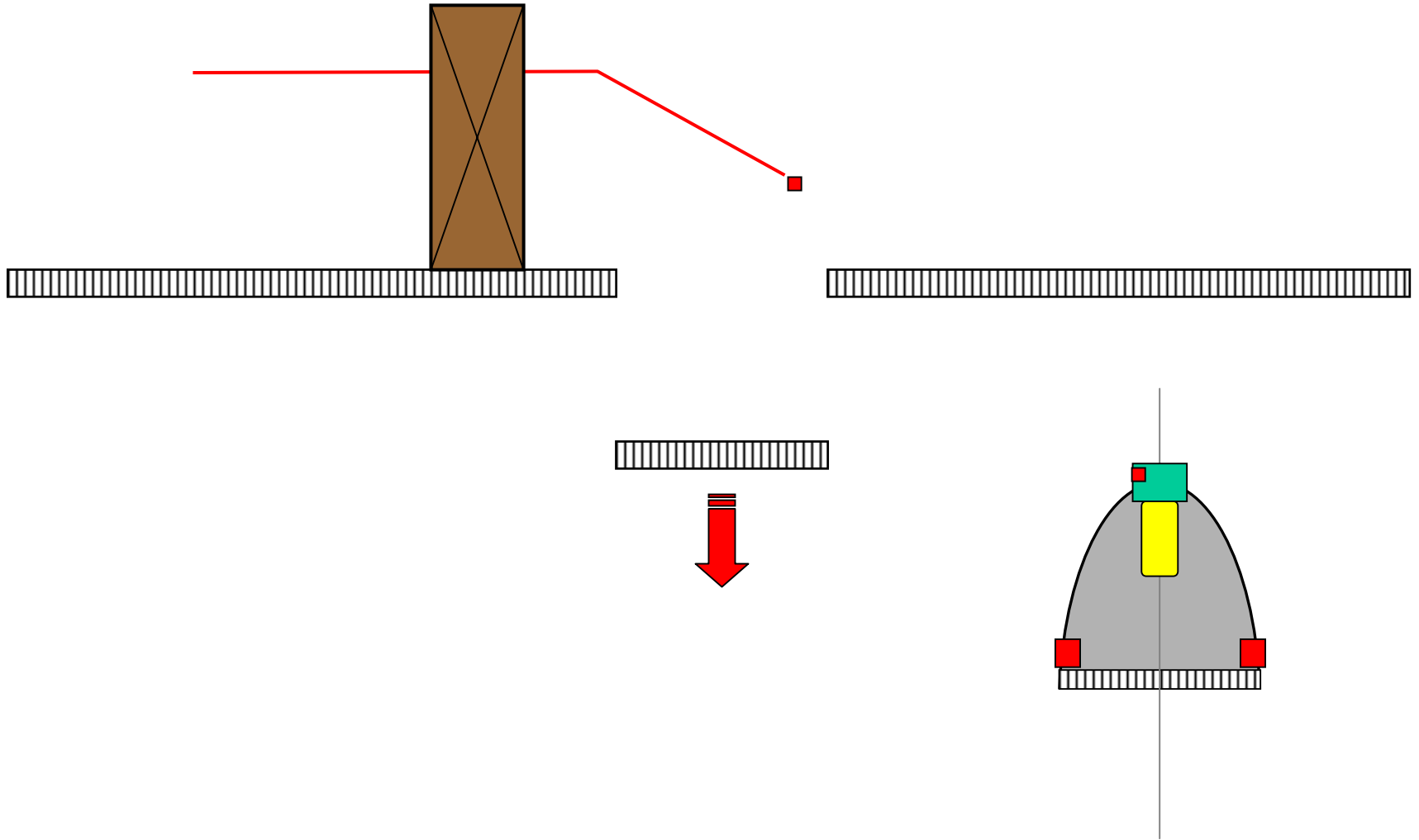


# Snap in Lock Support and Plug-in Wiring Harness

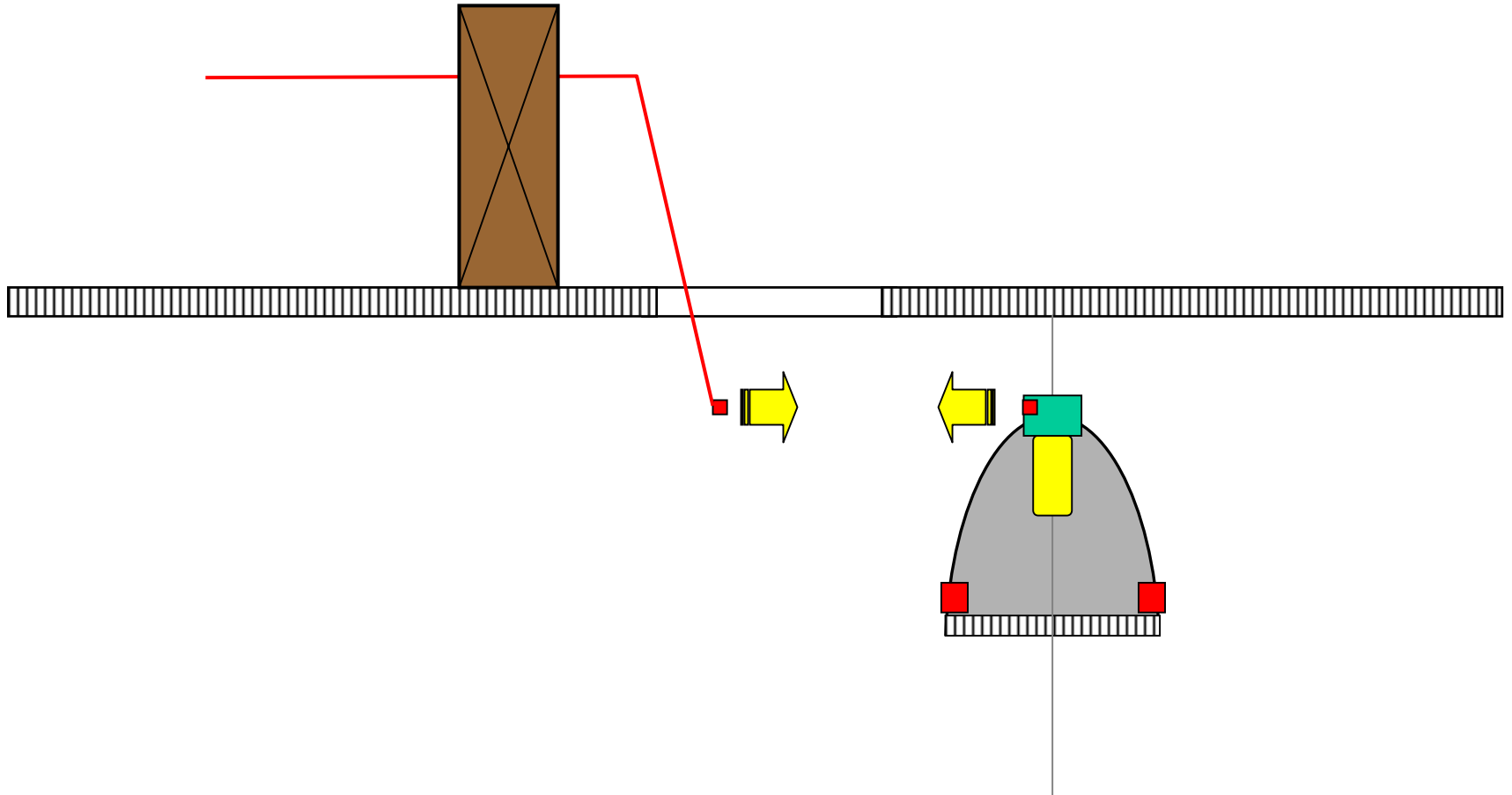




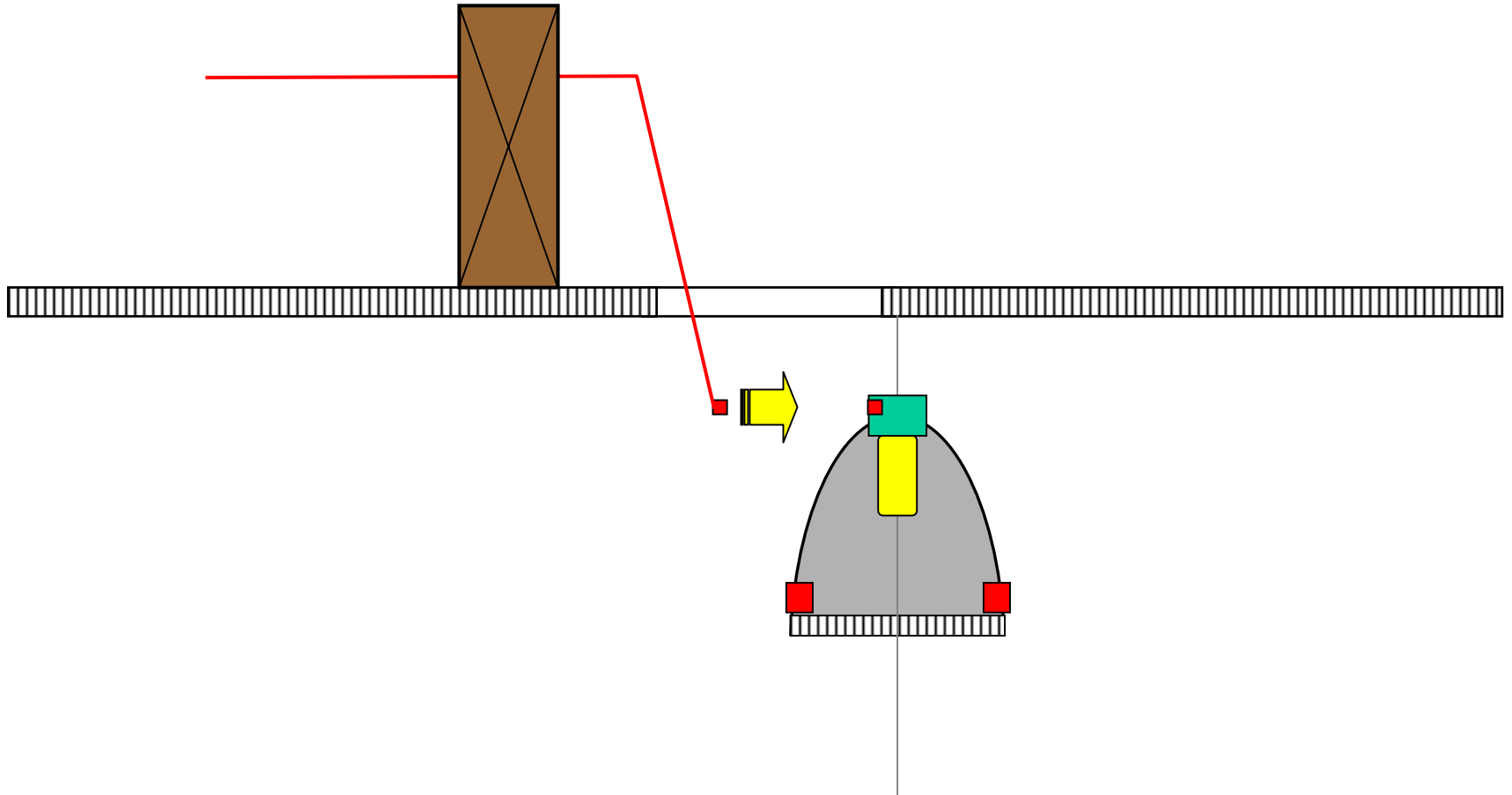
# Snap in Lock Support and Plug-in Wiring Harness



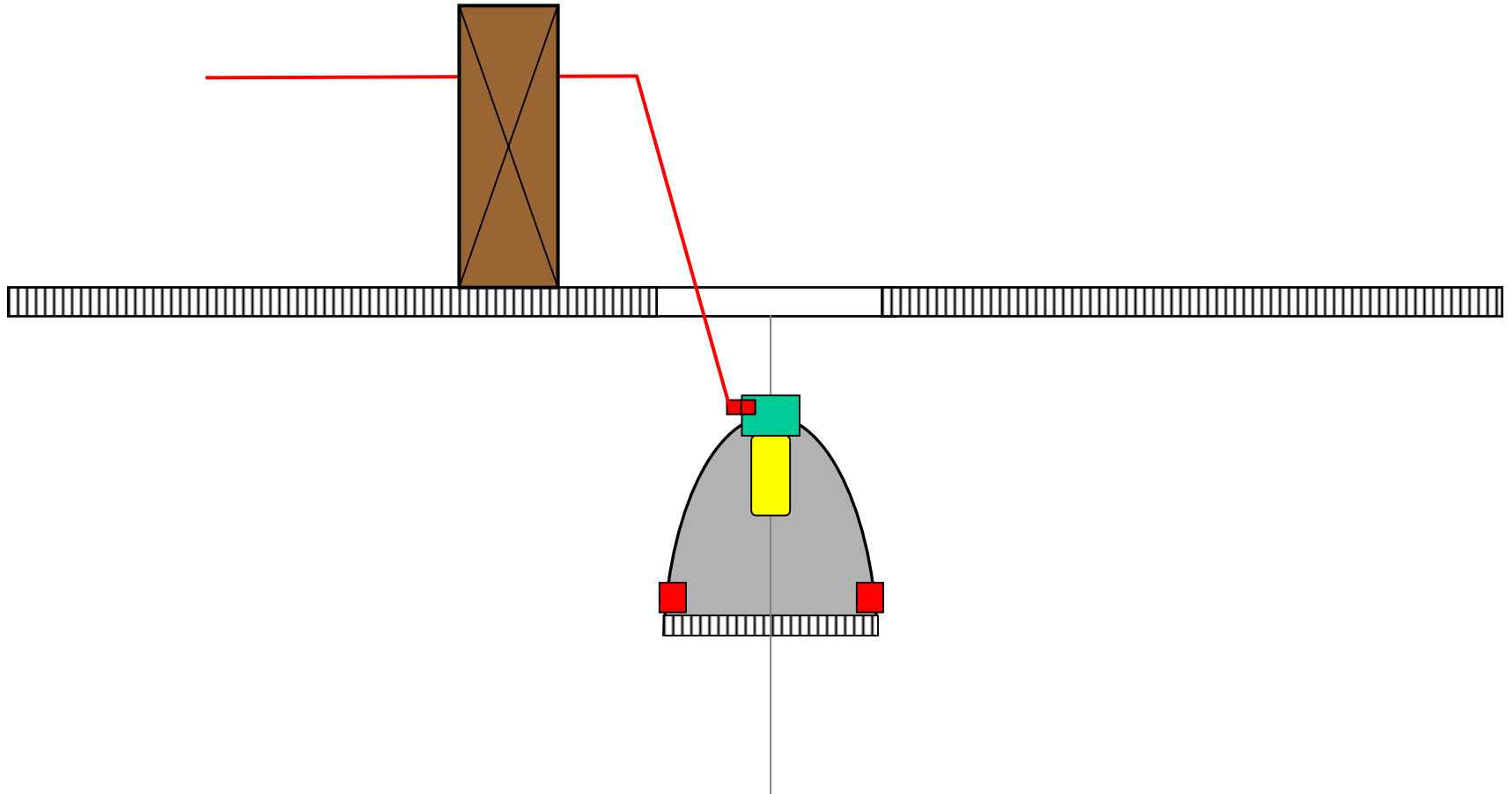
# Snap in Lock Support and Plug-in Wiring Harness



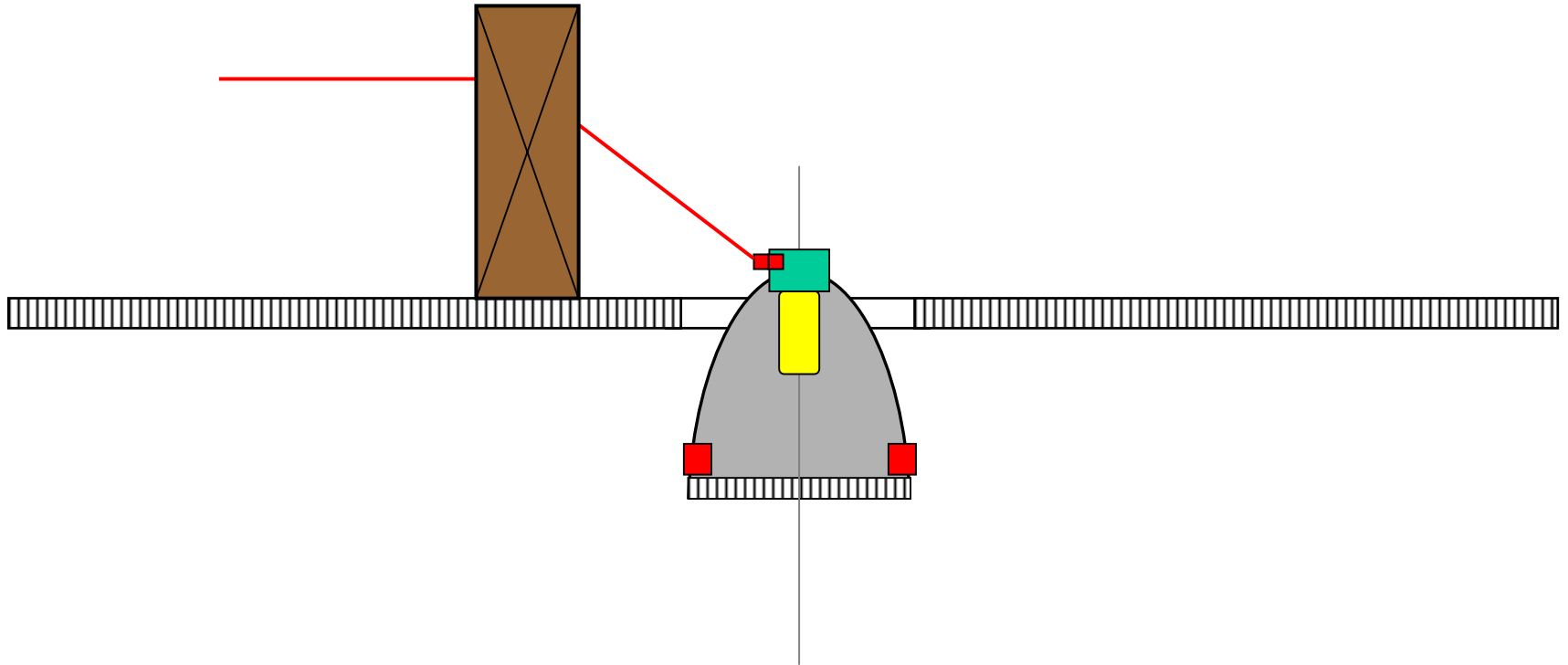
# Snap in Lock Support and Plug-in Wiring Harness



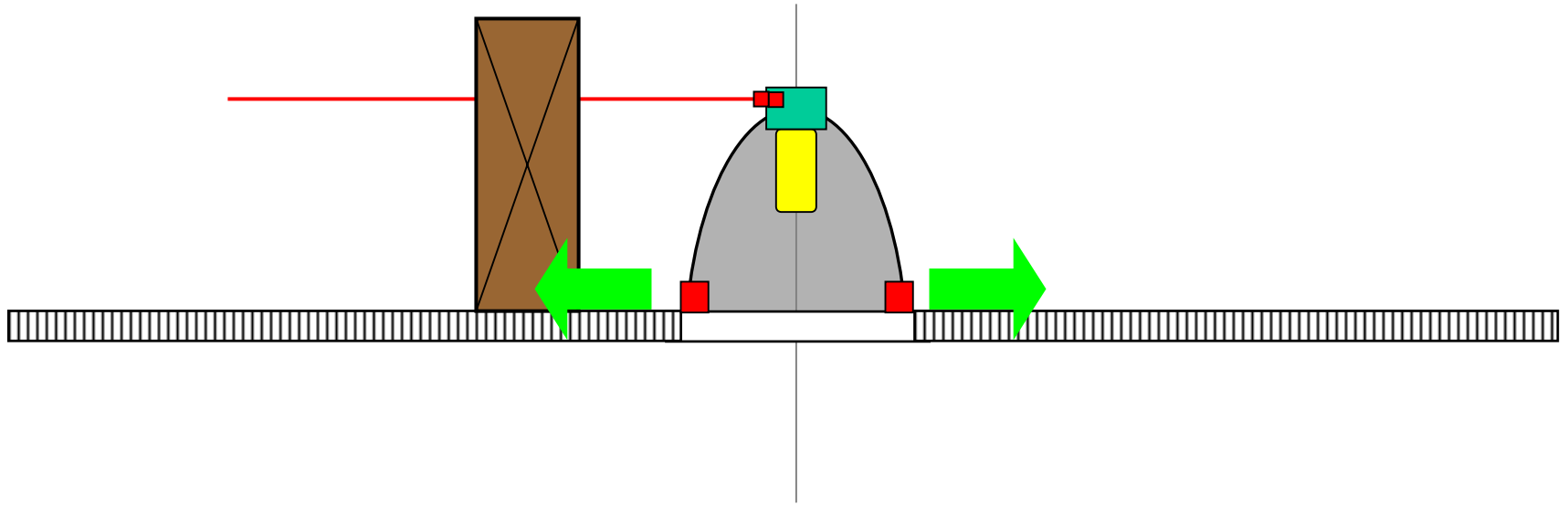
# Snap in Lock Support and Plug-in Wiring Harness



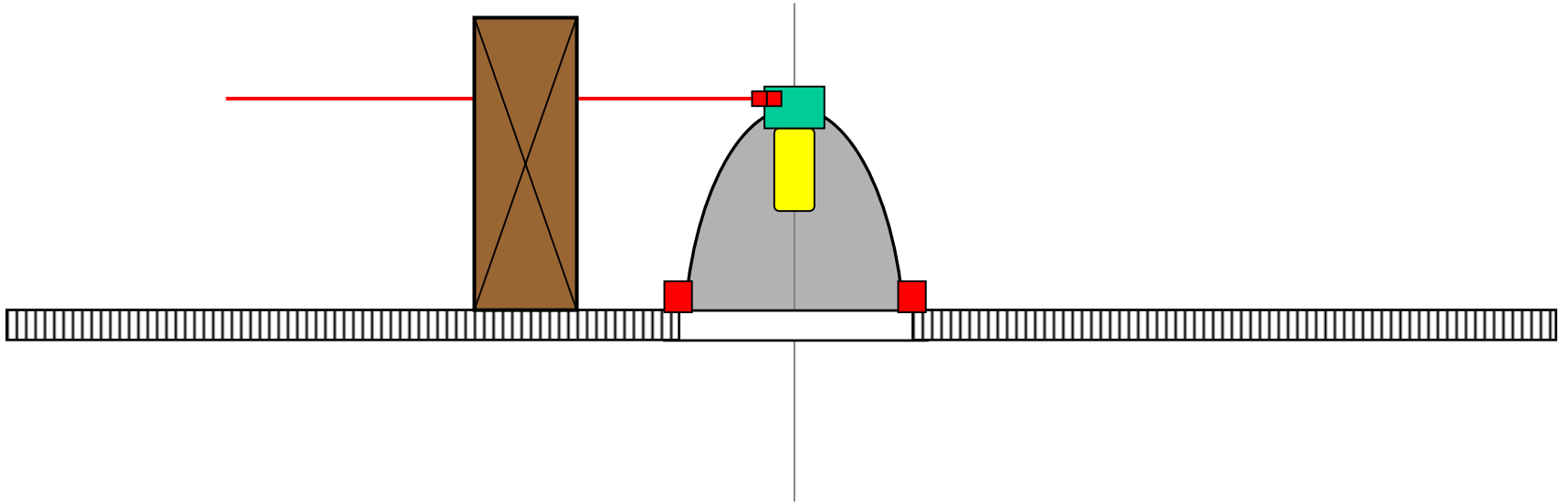
# Snap in Lock Support and Plug-in Wiring Harness



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# Snap in Lock Support and Plug-in Wiring Harness

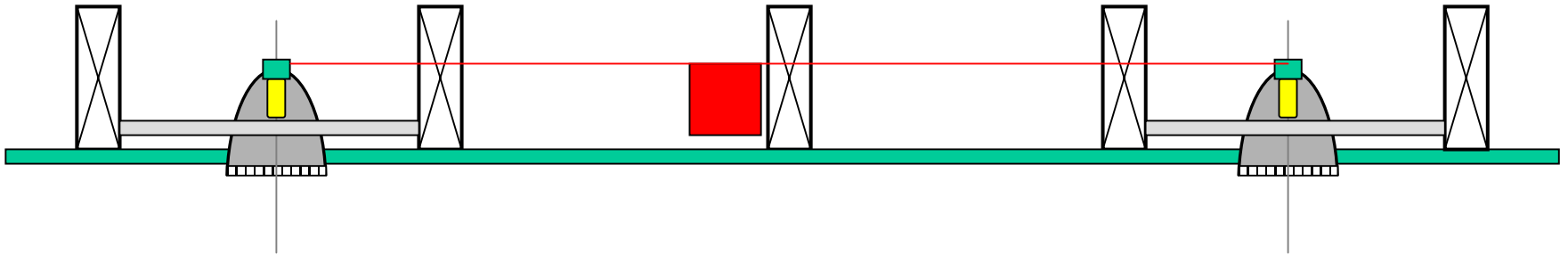


# Other Centralized Ballasting Options

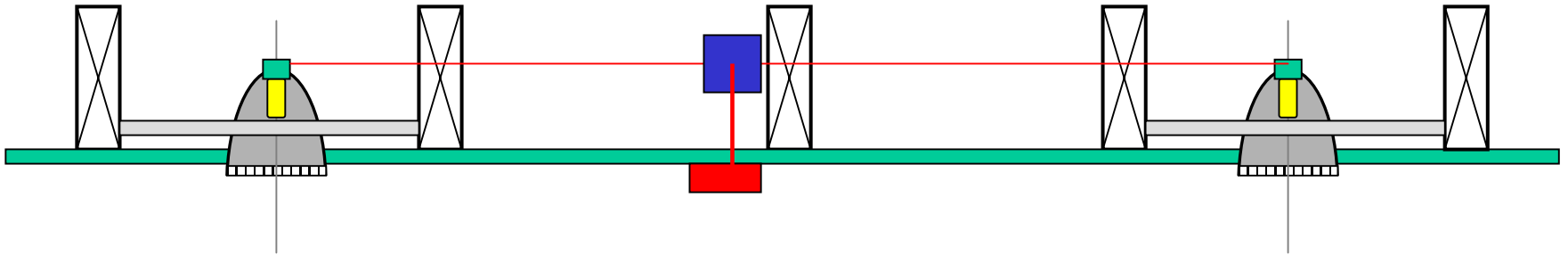
- Ceiling mounted
- Joist hanger
- Wall mounted



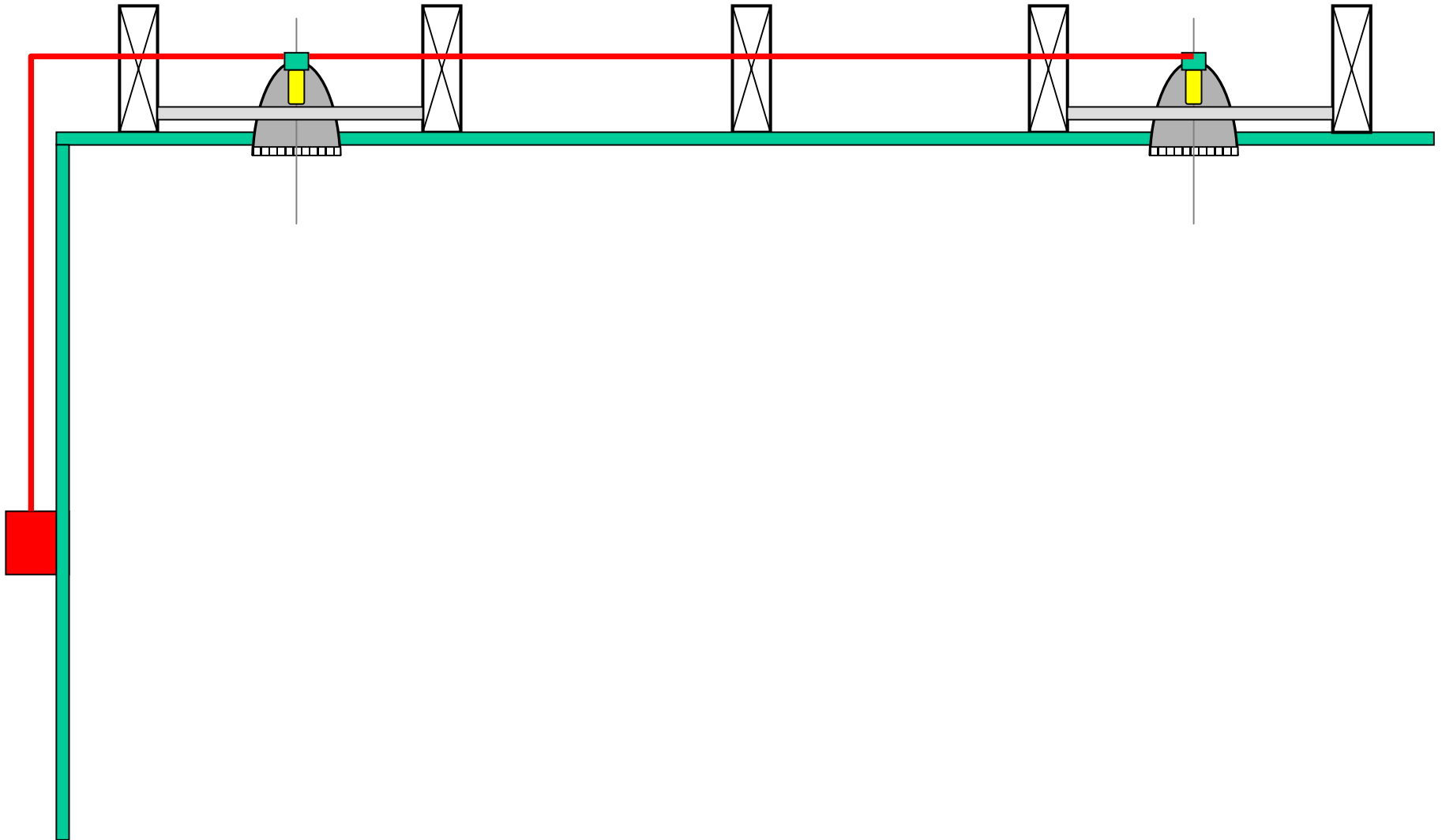
# Surface Mount Only Centralized Ballast-ceiling-joint Hanger



# Centralized Ballast-ceiling-joint Hanger (Ceiling)



# Centralized Ballast-ceiling-joint Hanger (Wall)



# Builders-Next Steps

- *Review concept with builders*
- review prototype systems
- participate with lab demonstration
- high visibility demonstration-**advantage**  
**home builders program**